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SCIENCE

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THE NEEDS AND OPPORTUNITIES IN PARASITOLOGY[1]

IN these days of many organizations and calls for service in so many directions where work and workers are clearly needed, the formation of any new society can be justified only on the basis of imperative necessity. Such a necessity may be evidenced by the importance of the topic and a rapidly growing content of special knowledge; or the increase in the number of workers in the special field may demand some means of discussing and coordinating the service which this field can render. Yet, if all this be true, the demand can be justified not merely because it is so imperative at the moment that it can not be resisted, but rather that it gives clear promise of continuing future opportunity and need. Otherwise science will not jutisfy the waste of time and the dissipation of energy which should rightly be devoted to more permanent ends.

Now all these conditions are satisfied in full measure by the facts in the field of parasitology to-day. Indeed the situation seemed clear some years ago to those who were working in this particular line, but in common with others I resisted the movement for the organization of a new special society in the effort to achieve the necessary results through cooperation with existing agencies. But that affiliation did not prove adequate to meet the needs which were growing with startling rapidity, and one may say justly that the formation of the new American Society of Parasitologists was forced on us by the pressure of circumstance.

Substantial justification of this action is found in the fact that to-day the membership roll includes more than three hundred names, although the society has not passed its first birthday, and that it brings together at this meeting about one sixth of that membership for active participation in the work of the organization. This is a record rarely if ever equalled in a national society with a membership which covers in fact the length and breadth of our country and even goes beyond those limits. Surely the membership may properly be called active and the organization justified from the standpoint of numbers and interest. Did time permit, further justification would appear in a survey of the number of courses on the demand for such instructions from students in

[1] Address of the President read at the first annual meeting of the American Society of Parasitologists, Kansas City, Dec. 30, 1925.

parasitology introduced into colleges and universities, general, medical and veterinary science, the long list of teachers and researchers engaged in developing the subject and the widespread interest in the work and its results.

Even though workers in parasitology know the magnitude and richness of the field, it may be worth while to review here in brief some facts that illustrate the task which the society has undertaken. The subject of parasitology goes back for its beginnings to the very earliest days of history. Among the first records preserved for us in writings of antiquity are evidences that the human race was afflicted then by some of the familiar parasites of to-day. The blood fluke of the Egyptians, the fiery serpent of the wilderness, the Ascaris and other conspicuous forms are discussed at length in the records of those early days.

But however definitely man may have recognized the presence of some such organisms, very little was known of the range of parasitic life or of its rôle in the causation of disease, both in man and other animals, until very recent times. To be sure, the last century accumulated a considerable mass of evidence concerning the occurrence of the larger parasites and some facts concerning their structure and biology; but it was left for this century to elucidate the complexities in life histories which made the subject so incomprehensible to students of biology fifty years ago, and to furnish thereby the methods by which the spread of these organisms can be arrested and the losses incident to them prevented. Seventy-five years ago the life history of trichina was worked out and the way found for avoiding the epidemics of trichinosis that were prevalent in those days. It is exactly forty-five years since Laveran demonstrated the presence in the blood of the malarial organism and enabled science to take the first step in the solution of the malaria problem. But instances as old as this are in reality few. The growth of parasitology belongs to the twentieth century.

It is just twenty-five years since Grassi published his famous "Studies of a Zoologist on Malaria," and the opening days of the present century saw the demonstration of the life-cycle of the malarial organism in the mosquito and of the method of transmission through that type of insect. It is just twenty-four years ago that the famous Yellow Fever Commission, headed by Dr. Walter Reed, with his associates, Drs. Carroll, Lazear and Agramonte, started in Cuba the series of experiments which led to the demonstration of the method by which that disease was transmitted. Out of this discovery have grown measures which have all but exterminated yellow fever from the surface of the earth. Such illustrations could be multiplied, but time does not permit. It may rightly be said that parasitology is in a real sense the product of the twentieth century.

It is fitting to introduce here a few words on the part of our country in this work. Despite the newness of the field and previous lack of organized effort in the United States, workers here have contributed in most significant fashion to the marvelous discoveries which have opened up this field, and have played an important part in the solution of the problems which have commanded the attention of investigators in these recent years. In another connection I have discussed the pioneer work of Dr. Joseph Leidy, who, studying practically alone in this field, added so richly to our knowledge of parasitic species and deservedly is recognized as the founder of American parasitology. In these later years of the twentieth century contributions have come from a series of workers. It was MacCallum who first described certain phases in the sexual cycle of the malarial organism and thereby contributed an indispensable element to the solution of the malarial problem. It was Stiles' acumen in distinguishing Necator that brought clarity into the hookworm problem. By experiment that ultimately cost him his life, Walter Reed demonstrated the rôle of the mosquito in transmitting yellow fever. The work of Howard Taylor Ricketts, again at the cost on his part of the supreme sacrifice, contributed to the knowledge of typhus and made it possible to save thousands of lives in the armies and among the people of later days. It was Noguchi who laid the keystone in the arch of discovery for yellow fever by demonstrating the nature of the causal organism.

Even more in the application of these discoveries, perhaps, than in their demonstration, has this country performed a service of which it may well be proud. The work of the Rockefeller Institute in prosecuting researches in malaria, hookworm and yellow fever, in organizing campaigns for the limitation and ultimate extermination of these diseases and in extending this activity beyond the limits of our own country to embrace the four corners of the earth, has utilized the services of parasitologists and the rapidly growing knowledge of that field in outstanding fashion for the service of the nation and the world.

It is not necessary before an audience like this to recount the contributions of parasitology to human and comparative medicine. Researchers in parasitology have contributed in large degree to the suppression of disease and the welfare of humanity. These contributions have been most conspicuously utilized in the tropics and so have given a material basis for the association of parasitology with the field of tropical medicine. One can not question the justification of such a connection. Parasitic diseases

are rampant in tropical regions and by their frequency and virulence have set a limit to the utilization of tropical resources; by their presence the white man has been practically excluded from the most fertile areas on the surface of the earth and the population of these regions has been restricted to small numbers of primitive peoples who have not been able to develop a type of civilization equal to that which obtains in temperate climes.

In recent years the conviction has been growing that the importance of parasitology is not limited to the Tropics but extends far beyond those regions. A record of the cases of amoebiasis treated at the Mayo Clinic shows that the disease has originated in all the northern states, including also Canada and Alaska. Far from being limited to tropical regions, this complaint extends to the northern limits of human residence, wherever the social conditions are favorable to its inception and transmission. Before the cause and the method of transmission of yellow fever was known this dread disease ravaged Illinois and even Philadelphia, as it did in the last century. This can never occur again. The bubonic plague, which in centuries past has swept around the earth at regular intervals and has exacted a terrible toll of human life, can now be met at the border of the nation with confidence that the scientific knowledge in possession of sanitary officials is adequate to arrest its spread and protect the people against its ravages. *Parasitology is a world topic.*

One may with apparent justice charge that this account has concerned itself up to the present moment with the achievements of the past rather than the needs and opportunities for the future. Yet the picture of the past, even if sketched only in barest outline as has been done here, gives promise of the future. The record of a few species in which the work of our precursors is shown so brilliantly stands out all the more conspicuously because of the lack of definite knowledge concerning the many related or associated species which have not been studied. The oft-repeated experiences of others have demonstrated the need of extreme caution in observation and inference. Even the most distinguished of parasitologists a generation ago confused species like Opisthorchis and Dicrocoelium that in fact differ rather strikingly in structure. In the celebrated case of the English schoolship Cornwall, failure to diagnose correctly a small nematode all but precipitated a political upheaval. Similar cases of confusion of much more recent date obscure the literature of parasitology to-day and serve to demonstrate that the urgent need of the present is greater accuracy, more precise determination of the facts based on more prolonged and exact study of the material. We have all of us been guilty of high crimes and misdemeanors of this type and I for one am glad that an increased number of workers with a growing supply of contributions will force more exact consideration of the worth of each particular study and afford more immediate critical examination of the results obtained by any worker.

It is wise to point out here in particular fashion how the situation affects the progress of parasitology. If one errs in naming the species of free-living flat worm, which is under observation, the result is not very serious, but if the structure, life history or biology of a parasite be the subject of the investigation, a similar error may introduce serious confusion in the diagnosis of the disease caused by it, the use of anthelmintics in treatment or the application of preventive measures. All these conditions are real and not supposititious and each of them may be illustrated by definite examples.

In considering the human parasites which have been probably more carefully scrutinized as a group than any other set of species, one still finds great uncertainty as to general features of size and form, and many of the doubts would not have arisen if the earlier authors had exercised greater care in observing and recording the facts. A comparison of twenty text-books demonstrated numerous important discrepancies in the technical descriptions of the chief species of the flukes found in man. There is real need of extended morphological studies, even on well-known species of parasites, and a wealth of forms remain as yet entirely undescribed. In respect to biological features and to life histories the situation is much more striking. In the main we must depend on knowledge of the life cycle and of the habits of a parasite to furnish a foundation for the plans of attack upon it. And if information be imperfect or lacking, successful methods of preventing parasitic diseases can rarely be devised.

The lack of exact knowledge on an important relation between parasite and host is well illustrated by the case of the pinworm, *Oxyuris vermicularis*. It is nearly two centuries since Fabricius (1634) recorded the presence of this parasite in the human appendix vermiformis and similar observations recur in the literature frequently for more than one hundred and fifty years after that before the distinguished Metchnikoff (1901) emphasized the significance of this occurrence and assigned definitely to the parasite a causal rôle in appendicitis. Little serious consideration has been devoted to Metchnikoff's suggestion. More than twenty years ago I sent to several surgeons a personal appeal for excised appendices, stating that I was very anxious to test this supposed relation. I did not secure a single specimen. Why? Not that my correspondents were

unfriendly, quite the contrary, some of them were much interested and went to the trouble to write at length in order to explain to a young man the improbability of such a relation. The pinworm was too uncommon, its presence in the appendix was very unlikely, and even if it should be there it could not give rise to ulcerations of the intestinal wall. In evidence of all these contentions they cited the writings of parasitologists and authoritative texts on medicine. In consequence my project was abandoned.

The question has been argued extensively, but only in very recent years has it been studied. In 1920 Rheidorf carried out an exhaustive histological and pathological study of the intestinal mucosa which led him to the conclusion that the pinworm played an important part in the causation of many cases clinically recognized as appendicitis. Others have followed him with further evidence on the relation. Moreover, on the question of frequency Japha (1925) has just published a really careful investigation on the presence of Oxyuris in school children. In the place of a frequency of 20 to 33 per cent. given by early writers, he finds from 64 to 86 per cent. with an average of 73 per cent. in a city population in Europe. His figures are confirmed by other records of examinations on city school children and are contrasted with much lower percentages among country school children.

In comparison with these figures from the Old World may be brought forward those obtained in a study of hospital cases in this country made last year by Harris and Browne (1925). They found in one uninterrupted sequence of 121 cases of operative appendicitis that *Oxyuris vermicularis* occurred in twenty-two of the appendices removed. They say further: "The failure to recognize Oxyuris as a factor in the production of appendicitis is due in general to lack of detailed gross and microscopic study of the appendix. . . . The observations on record of the frequent relationship of Oxyuris to appendicitis justify a more general and thorough study of the subject."

How is the desired accuracy to be obtained? Some workers have sought to gain it by introducing for parasites trinomial designations. We deceive ourselves if we forget that precision is not achieved by means of words. The use of varietal names has no justification to-day in parasitology. In the present state of knowledge such designations are really due to inexactness. The author either had an imperfect picture of the original or an incomplete conception of his own specimens, so that the comparison in his mind was hazy and he sought to express this condition by refusing to decide whether the parasite being studied was new or old. He called it a variety and thus found an easy escape from arduous mental labor, but left the real scientific problem for some more capable successor.

Equally unfortunate in my opinion is the tendency, which is spreading, to devote much energy to the interpretation of ancient writings and at one's desk to determine by logical analysis of the text what one of the worthies of a century or more ago had in mind when he wrote a two-line description that in fact might belong to several species, known or unknown. Desk work has a clearly subordinate value in biology and neither in teaching nor in research shall we make adequate progress unless we follow the admonition of Agassiz and stick to our specimens until we know them.

The case of the pinworm discussed a few moments ago is only one of several that might be cited to show the opportunities for study of human parasites among the dwellers in cities where conditions have been most studied and are best controlled. If there are serious gaps in our knowledge of the presence of human parasites among city dwellers what shall be said of the situation in the smaller communities and in the country? There medical service is not fortified by hospitals, laboratories, clinical assistants and skilled technicians. Even the routine tests which are common in city practice are limited under the conditions of country practice, and often none are made. But the circumstances of country life expose the individual to new chances of infection from species which are wanting in the city. In the crowded life of the city infection comes chiefly from personal contact or from food and drink. While various measures, such as sewage systems, food inspection and water supply systems, are installed and maintained at great expense, the dangers of massing population and of defects in construction or management of the municipal systems are always present; and from the crowding and the failures of his protective measures the city man acquires in the main his parasitic infections and consequent diseases. To be sure, his pets are still to be considered. Since the passing of the horse, cats and dogs are the only domestic animals with which the city dweller comes much in contact. Now we know that cats and in even greater degree dogs are disseminators of parasites which are inimical to human welfare. Here again the fact is generally well established, even though more exact data are desirable. Stray dogs and cats exist in considerable numbers in our cities and in their wanderings in search of food distribute widely several types of animal parasites which threaten to infect the human species. While the stray animals are most deeply involved in the general distribution of such parasites, mention should be made of the fact that a few parasitic species, like

Dipylidium caninum, are extremely abundant in house dogs, and through the agency of such pets are transferred to children.

But on the whole the contact of the city man with domestic animals is so limited that it stands in sharp contrast with the situation in the country, where domestic animals of many sorts are abundant and man is in intimate and constant contact with them. Furthermore, no organized safeguards protect supplies of food and drink and chances of contamination are frequent. This menace is not so much from human contamination, although that is well known to exist in significant measure. The danger comes prominently from contamination due to domestic animals. The parasitologist would say in advance that here was a real menace to human health, but the question has really never been studied at all. What we know is based on very few observations and is supported at most by probability. It affords a new and promising opportunity for scientific research in parasitology.

A single case will suffice to illustrate the situation. *Ascaris lumbricoides,* the stomach worm of children and of hogs, is considered as a rare parasite of the human species in civilized regions and of consequently little importance except in those distant primitive communities of the tropics where its abundance in man is plainly recognized. Even in hogs, where it is very common in our own region, it has been considered in the past of little importance from the practical standpoint. Within very recent years several investigators have worked out together its life history. In this study the prominent part was taken by one of our own members, Dr. Brayton H. Ransom, of the U. S. Bureau of Animal Industry, whose untimely death last September was such a blow to many of us, endeared as he was to us by years of intimate personal contact, and also such a loss to our science and the country that he served so quietly and so well.

The life cycle of Ascaris includes as the initial part of its career in the host a migration from the intestines to the lungs and produces thereby a disturbance in young pigs known as thumps. This disease is serious and causes great economic losses every year in regions where raising hogs is an important industry. The elucidation of the complex conditions in the life cycle of the parasite, of the serious effects it has on the host organism, and of the method by which the parasites may be greatly reduced in numbers if not entirely exterminated, form one of the most brilliant chapters in the history of parasitological research and these discoveries will stand as a permanent memorial to the keen intellect, the careful work and the dogged determination of Brayton H. Ransom.

But what of the possible relation of this same parasite to the human host? The problem is one that concerns directly the country population. The pig and the parasite are everywhere abundant in the country, even in the most favorite parts of our region. The eggs of Ascaris are highly resistant, they are distributed widely by the movements of men and animals, and even by the action of wind and waters. The opportunity for human infection is always ready at hand and the chance of infection is evidently greatest in childhood. The parasite follows out in the human host the same migration through the tissues into the lungs and gives rise to the same symptoms that have been demonstrated in the case of the hog. How abundant is it in man and especially in children in the country? No one knows. One can not doubt that if present, its effects would be serious, directly in proportion to its numbers. It may easily be the cause of attacks of disease of a type now designated as indefinite and obscure because the cause has not been recognized and the symptom complex adequately analyzed.

Some parasitologists have maintained that the Ascaris parasitic in the pig is a different species from that found in man; thus far no one has demonstrated differences in structure or in physiological activities that would establish such a view, and final proof is needed. This question is important and constitutes one phase of the Ascaris problem which appears in the light of present knowledge a most fruitful topic for investigation, but after all only one of the numerous interesting problems in the relation of the country dweller to his environment.

As I proceed with this discussion the subject opens out before me like the road across the plains where each mile appears only to add to the length of the highway stretching out to the distant horizon; but the time to stop and make camp is surely nearer at hand. It has been a difficult task to select from the wealth of available material a few items to illustrate my thoughts, and all of you can add instances of equal or even more striking character. The few that I have selected have left scant time even to mention other great phases of the subject on which we are working. The contributions of parasitology to comparative medicine have been no less striking if somewhat lower in personal import than those made to human medicine. The two phases of the subject are so intimately interwoven that no natural separation can be found. Many parasites are transferred from man to other animals and *vice versa.* Problems of the frequency, distribution, virulence and prevention of human parasitic diseases involve concurrent consideration of numerous other species of animals from snails to man. But I must forego the pleasure of discussing further this interesting subject as well as the

equally remarkable records of parasitological research on all sorts of animals from amoeba to man.

The significance of studies in parasitology is by no means limited to the fields I have been discussing. Such studies have been shown to have a direct bearing in individual cases on problems of pure science, such as phylogenetic relationships, distribution and the origin of the parasites and their hosts. Kellogg's work on Mallophaga ultimately led to the demonstration of relations between groups of birds which taxonomists had suspected but had not been able to establish on structural evidence. Metcalf's studies on Opalina, a parasite of the frog, forced him to conclude that a previous land connection had existed between South America and Australia. There has been found in the record of the parasites of the salmon, clear evidence that these royal fish are oceanic in origin and that the freshwater migration is a secondary episode in the history of the race.

In a remarkable paper, published after his death, our late deeply lamented vice-president, Dr. S. T. Darling, wrote on "Comparative Helminthology as as Aid in the Solution of Ethnological Problems." Darling advanced the view that it is possible to trace the origin and migration of races of mankind through a study of the species of hookworm which man has harbored in different regions on the earth's surface. The evidence adduced from a study of the two chief species of hookworm, species which in fact are confined to the human host, shows that their distribution depends on the migration of their hosts and not on climate or soil. The world-wide contact which Darling had had with the hookworm problem gave unusual opportunity for securing evidence on the distribution of these parasites in different races. He observed that pure cultures of one species tended to be found in certain ethnic stocks and in certain geographic areas as well. By a careful analysis of the data he traced the origins and movements of primitive peoples in a way that seems at once to confirm and to check the views of those who have attacked the problems from other sides.

HENRY B. WARD

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THE SCOPE OF INORGANIC CHEMISTRY. II

PETROLEUM

The complex hydrocarbons which form the main constituents of crude petroleum belong to a section of organic chemistry at present too little explored. Although many millions have been made through the production and sale of petroleum products, it is safe to say that the percentage of profit devoted to research in oil products has been infinitesimal. It is true that in the United States large sums are given by the oil interests towards research in other subjects, but until quite recently none of these was, curiously enough, given for the purpose of improving our knowledge of the science on which the utilization and isolation of petroleum products depends. The reason is not far to seek. The apparently inexhaustible supplies of petroleum render it unnecessary to devise means for economical working. The crudest and most wasteful methods were employed, because economy and the conservation of the natural product were not paying propositions. This applies not only to the methods used in fractionization, but to those employed for the purpose of "cracking" the higher boiling fractions into liquids of lower boiling point. For at the present moment it is the fraction up to 200° C. which is the important product, because it is the "petrol" of the internal combustion engine. Time was, before the introduction of this particular machine, when the light fraction from crude petroleum was a drug on the market, and in many cases was actually set on fire at the refinery because no use could be found for it. In those days the chief product was the kerosene fraction which was used as lamp oil. At the present time the rapid increase in the use of the motor car for personal and commercial transport indicates that at no distant period, if progress continues to be made in the same direction, the amount of the "petrol" fraction will be insufficient for the world's needs. This point has already been reached in America, where approximately 70 per cent. of the world's consumption of petrol (gasoline) is effected. During 1925 the consumption of petrol in the U. S. A. approached 800,000,000 gallons a month, which is about twelve times the amount consumed in this country. It has been stated that one in every five persons in the States—men, women and children—possesses a motor car,[4] and, be this as it may, it is evident that to meet such a colossal consumption means have to be found to utilize the higher boiling fractions, and indeed even the residues from the distillation processes. This "cracking" operation is now carried out on an enormous scale by numerous processes, all subject to patents, but differing from one another but slightly on the question of principle. All depend on the well-established fact that hydrocarbons of high molecular weight will break down into those of lower molecular weight if they are subjected to the requisite degree of temperature. Pressure appears to play an important part in the character of the product, as does also the surface action of the container or material used in the container to promote surface action. All

[4] Cars registered on January 1, 1925, were: U. S. A., 17,591,981; Canada, 638,794; Great Britain, 1,094,534.

are wasteful, because little or no research has been carried out on the true chemical nature of the cracking operation. Much permanent gas is always produced, consisting for the most part of ethylene and propylene. In the States the ethylene is allowed to go free, because its obvious utilization in the form of ethyl alcohol is attended with difficulties, but the propylene is usually absorbed in sulphuric acid, and thus converted into *iso*propyl alcohol, useful as a solvent. The production of these two unsaturated hydrocarbons provides a clue to the mechanism of the cracking process which is of some significance. If you break a long chain-saturated hydrocarbon one of your products must be an unsaturated hydrocarbon, and it is evident that cracked spirit contains a considerable proportion of such unsaturated bodies. Moreover, the cracking processes at present in use do not produce aromatic hydrocarbons, and it is on the presence of a proportion of these aromatic hydrocarbons that certain special properties of petrol depend. For example, the tendency at the present time is to produce for motor cars internal combustion engines of increased compression ratio, in order mainly to diminish the petrol consumption and thus increase mileage per gallon consumed. For some reason, which research has not yet ascertained, the use of petrol which does not contain the right quantity of aromatic hydrocarbons of the benzene type leads to "detonation," "knocking," or "pinking" when ignited in cylinders giving more than a small compression ratio. This detriment diminishes the value of cracked spirit as such for any but low-compression engines, and many have been the devices suggested in order to overcome this difficulty. A vast number of substances, selected more or less at random, have been tried as "anti-knock" materials, and as an outcome it has been found that one, namely, lead tetraethyl, possesses the property, when present in exceedingly small quantities, of preventing the "detonation" of the explosion mixture in the cylinder. For a time lead tetraethyl (ethyl gas) fell under a ban in the States owing to a fatal accident which attended the spilling of a certain amount in one of the American factories, but it is understood that further investigation has led to a revision of the view first formed, and that considerable quantities of "ethyl gas" are now being used. The writer remembers visiting Wilmington in 1924, when some five hundred gallons of lead tetraethyl were being made daily. Although there was naturally a strong smell of the material in the factory building, and he remained for some hours there, no ill effects were noticed. It is obvious that the conditions which produce "knocking" and the reason why certain substances are "anti-knock" compounds, and why the presence of aromatic hydrocarbons prevents the phenomenon, must be made the subject of systematic research.

The question is also one of national importance, because in the case of high-compression engines, such as those used in aeroplanes, it is essential that a petrol should be used containing a high percentage of aromatic hydrocarbons. In war time these aromatic compounds will be required for the manufacture of explosives, and it is quite certain that there will not be enough for both purposes.

Nevertheless, it must be remembered that it is only at the moment that the low boiling fraction of petroleum is the chief marketable product. It is probable that progress in the future will tend more and more to produce a motor-car engine of the Diesel type, or one having a carburetor capable of effectively vaporizing the higher fractions of petroleum. In these circumstances it may well be that the low fraction will become the less important part of crude petroleum, and that, instead of having to resort to "cracking," a process of synthesis, by which the lower hydrocarbons can be converted into higher ones, will have to be adopted. As a matter of fact there are methods known by which this can be effected. Pure *iso*amylene can, for example, be converted into diamylene by interaction with stannic or aluminium chloride, and the process can be carried further, so that perfectly good lubricating oils can now be made by the polymerization of the lower unsaturated hydrocarbons.

Polymerization and depolymerization are, therefore, the two operations which the petroleum industry must investigate and establish on a firm scientific basis by research, so that it may be in a position to supply the public need for any particular form of engine which the engineer may evolve. Especially is it desirable to ascertain under what conditions polymerization leads to the formation of aromatic and naphthenic hydrocarbons. Considerable attention has been drawn within recent times to what may be termed in general the Bergius processes for depolymerizing organic substances. The operation, which consists in heating the material under high pressure in the presence of hydrogen, was introduced in the first instance for the treatment of coal. There can be no question that great and fundamental changes are brought about in organic substances by the treatment whether a catalyst is present or not, and that a wide field for research is opened up thereby, but it is doubtful if, at the moment, general operations of this type can be regarded as commercial propositions. The plant is exceedingly costly and the conditions subject to wide variations which are difficult to control. Actually it has been ascertained that in the "cracking" of the kerosene fraction of petroleum hydrogen is un-

necessary, and can be replaced by nitrogen without affecting the character of the final product.

Little is known of the constituents of crude petroleum, or indeed of the fractions into which it can be separated after purification and distillation. Some of the simpler hydrocarbons of the pentane and hexane type have been isolated and the presence of cyclic compounds has been established. Many of them are classed under the head of "naphthenes," but these are of uncertain structure. No doubt many are present in the crude oil, but it is certain that others are formed during the distillation process. It is clear that much opportunity for research work offers itself here, and it is probable that small alterations in the method of distillation may cause deep-seated changes in the character of the distillate, causing it to be of greater service for particular purposes. The occurrence of hydrocarbons of the naphthalene series in petroleum products has also been clearly established. The higher fractions which constitute the valuable lubricating oils also need attention, for it is now certain that viscosity bears no relation to oiliness, that is, the capacity for acting as an efficient lubricator. The addition of small quantities of "polar" substances of the type of fatty oils or acids confers increased oiliness on these compounds, and although we are now gradually reaching a stage when we know more about the effects of such ingredients, the field for research is still a large and important one.

The formation of free carbon occurs during both the distillation and "cracking" process, in some cases to a very considerable extent. The utilization of this carbon for the purposes of making electrodes is an important part of the industry, and the formation of carbon in a condition in which it can be used by the rubber tire manufacturers is also likely to become practicable as an outcome of the thermal decomposition of hydrocarbons.

At present we know nothing about the structure of the hydrocarbons present in the lubricating oils. Indeed, it seems possible that these may not be long-chain hydrocarbon with which the organic chemist is familiar, but rather polymerized products formed from unsaturated components liable to be formed or destroyed under comparatively mild conditions. The relative ease with which the oil in the engine sump of a motor car loses its oiliness through continued use is not characteristic of the stability usually associated with an organic hydrocarbon. Recent researches on the formation of dimeric products of the simple type

$$\begin{matrix} XCH=CHY \\ XCH=CHY \end{matrix} \rightarrow \begin{matrix} XCH-CHY \\ XCH-CHY \end{matrix} \quad \text{or} \quad \begin{matrix} XCH-CHY \\ YCH-CHX \end{matrix}$$

shows that the ease of formation and stability of such systems depend on the composition of X and Y. In some cases stable complexes of this kind are formed which can be distilled without undergoing disruption, but which are broken down slowly on prolonged heating even at a moderate temperature.

In the complex hydrocarbons under discussion the letters X and Y represent hydrocarbon residues, probably themselves containing other unsaturated linkages, and under the conditions of high pressure which were probably present during the formation of natural petroleum it is possible that many of these four-membered rings are formed in a single molecule, for example:

$$\begin{matrix} XHC-CH-CH_2-CH-CHX \\ | \quad | \quad\quad | \quad | \\ YHC-CH-CH_2-CH-CHY \end{matrix}$$

an expression which, incidentally, indicates the manner in which the cyclohexane complex can also be produced by a similar process. So far as the chemistry of petroleum is concerned this is at present mere surmise, which must be investigated as soon as practicable. The view is, however, rendered plausible by the work which has been carried out at the Imperial College during the past five years, which shows conclusively that the formation and stability of ring systems depends on the character of the groups attached to the carbon atoms forming the rings, and is not merely dependent, as Baeyer supposed, on the tetrahedral angle of the carbon atoms involved. It is probable also that a similar explanation may account for the "naphthenes," and will provide a general explanation of polymerization and depolymerization upon which it will be possible to base improved technical processes.

The composition of petroleums varies in accordance with their origin. Some are rich in aromatic hydrocarbons, and some are practically sulphur free; others contain so much of the last-named element as to render them unfit for use. The Kimmeridge shale oils are instances of the latter type, although doubtless if it were a paying proposition the sulphur could be readily eliminated from these products. The oil from the Persian, Mexican and Ohio fields contains sulphur which has to be eliminated during the process of refining. Among the sulphur compounds present mercaptans and thioethers have been identified, although whether they are present in the crude oil as such, or whether they are formed during the refining process is still an open question. Their removal by washing with liquid SO_2, an operation which is now carried out on a very large scale at the refineries at Skewen, is of interest.

It is clear, therefore, that the need for systematic research into the character of petroleum products is urgent, and it is gratifying to note that the Anglo-

Persian Oil Company has established a research laboratory at Sunbury-on-Thames, in which the important principles underlying the industry have been and will be studied.

DYESTUFFS AND INTERMEDIATES

Prior to the war Germany manufactured three fourths of the dyestuffs required for the world's markets. Of the remaining one fourth, one half was made from German intermediates and was, therefore, dependent on Germany. Switzerland, although without a domestic source of raw materials, ranked second with about 7 per cent. of the world's production. Great Britain produced about one tenth of her requirements, and France produced in French-owned and operated plants from 10 to 15 per cent. of her consumption. In order to meet the patent requirements of France and Great Britain, German manufacturers operated plants in those countries where the final assembling operations were completed. The small dye industry of the United States was almost entirely dependent upon German intermediates. At the present time Great Britain produces 80 per cent. of the dyestuffs required for our own use, and we are, therefore, in a position to review the conditions which have led to this remarkable change and to consider the procedure necessary to strengthen it. It can not be said that any fundamental advance in the chemistry of the dyestuffs has been made since Bohn discovered indanthrene in 1901, although great advances have been made since then in the preparation of new colors belonging to this and other known series. Consequently, the research work necessary in order to establish our position as a dye-making country has been mainly along known lines, involving the extension of reactions which had already been established rather than the discovery of new ones. Nevertheless it is no inconsiderable achievement for our research chemists to have established a position such as that indicated above in so short a space of time, for many of the preparations, the details of which could only be found in the patent literature, had to be worked out *de novo* and the correct conditions found for their adaptation to the technical scale. It is probably along the lines of decreased cost of production that research work in the immediate future will be mostly engaged, and especially is this the case with the intermediate products from which the dyestuffs are derived. Moreover, the intermediate products are of the greatest importance for other industries, for example, the fine chemical industry, the perfumery and the explosives industries, and any improvement in the processes for their manufacture or the production of new compounds having enhanced value from the commercial point of view is of the greatest importance to all these industries alike. The parent substances of the intermediate products are the hydrocarbons of coal-tar or the coke oven by-products. The operations required to convert these hydrocarbons into the finished intermediates often involve many stages, any one of which depends for its cost on the purity and yield of the product. When large quantities are involved a difference of 1 per cent. in the yield may lead to a considerable difference in the cost of production, and it is obvious that reactions which yield their products in a state of purity sufficient for the market or further stage production without subsequent treatment make for reduced cost in production. There is thus a wide field for research into the improvement of technical methods which may well occupy the attention of our dyestuffs chemists for some time to come. On the other hand the question of fundamental research into new processes, both for the preparation of new intermediates and new dyestuffs must not be lost sight of. The intermediate determines the character of the dyestuff, and it is always possible that a new intermediate may be discovered which will yield a dyestuff with just that difference of shade as to catch the public fancy, and which will lead to the replacement of the older dyestuff on the market. The sulphonic acids of the naphthol, naphthylamines and amino-naphthols are cases in point. These substances are used extensively for the preparation of azo dyes. There are a great number of these compounds theoretically possible, but only a few have found technical application owing mainly to the high cost of producing the others. The high cost is nearly always caused by poverty of yield, an objection which may be at any time removed by the discovery of an improved process. The same argument holds good for the dyestuffs themselves. It is futile to say that the vast field of organic chemistry has been thoroughly explored for the production of new types. At any moment one or other of the men or women engaged in fundamental research may repeat Bohn's discovery of 1901, and obtain a new compound which will be the forerunner of a new series of dyestuffs. It is perhaps too much to ask an industry which is struggling to hold its own to expend large sums on the prosecution of abstract research, most of which will be of no use to it, but it is not too much to expect that the industry will take every means to foster and encourage abstract research in our university institutions, and even to give some lead as to the direction in which its experience leads it to think that advances may be made. There is at present no organization which can bring the manufacturers of dyestuffs and intermediates into touch with the work being carried on in our university laboratories, and

it is possible that if at the present time a valuable discovery were to be made it would be unrecognized as such, and, following the usual course of academic research, would be published and thus lost to the country. What is required is a lead from manufacturers which will indicate the matters which they regard of importance, but which they do not consider as likely to yield results sufficiently quickly to justify them in employing their own research staff for investigating them. This aspect is of all the more importance at the present time, when organic chemistry is entering on a new phase which will undoubtedly revolutionize many of the existing processes of manufacture. It is now recognized that the presence of a small quantity of a catalyst may either alter the course of a reaction or may lead it to proceed to completion where otherwise a totally inadequate yield would be obtained. The catalyst may either be added or the containing walls of the reaction vessel may act in this capacity. The well-known example of the oxidation of naphthalene to phthalic anhydride by vanadium pentoxide is an example of this, but similar cases are continually recurring, and it has only recently been found that the classical method for preparing ketones by the distillation of the calcium salt of the appropriate acid can be utilized in the most unexpected directions if the thorium salt instead of the calcium salt is employed. It is perhaps appropriate to conclude this section by the following quotation from the United States Tariff Commission Report, No. 32:

> The acute shortage of dyes arising in the various dye-consuming markets, due to the disappearance of German dyes shortly after the beginning of the war, was soon followed by prices of unprecedented levels, while certain dyes were not to be had at any price. This dye famine threatened the activities of the vast textile industries, as well as other industries dependent upon dyes for their operation. The manufacture of dyes was soon entered upon in the United States, Great Britain, France and Italy, and each of these countries has developed a dye industry capable of supplying from 80 to 90 per cent. of its requirements and has, in addition, exported significant quantities of dyes since the war. As a result of this remarkable period of expansion and development the world's present capacity to produce dyes is nearly double that of the pre-war period. This existing capacity to produce over and above normal requirements is resulting in an era of severe competition in the world's markets which may eliminate many of the plants now in operation. The German industry has certain advantages over the industries of the new producing countries, including cumulative experience, unified organization for buying and selling, and lower manufacturing costs. The high post-war price levels of dyes exported from Germany would appear to indicate a strong probability of price reductions during the next few years. The commercial warfare which is likely to follow may involve the utilization of such methods as full-line forcing and dumping, such as was practiced by the German chemical industry prior to the war. The retention of a tariff and other protective measures by the new producing countries will doubtless lead the German industry to form affiliations to establish branch plants in those countries. The war made clear the relationship of the coal-tar dye industry to the production of munitions, war gases, medicinals and other essential products, and demonstrated the desirability of home dye production as a means to prevent shortage in times of war. This will probably result in an effort by the large industrial nations to retain dye industries of sufficient size to meet peace requirements and to provide for war emergencies. Reduced production costs and constructive research will be vital factors in the maintenance of their competitive place in the world's trade.

This seems to sum up the situation with which we are at present faced.

PUBLICATIONS

Our chemical publications grow apace—already they have outstripped in number and size those produced prior to the war. If one may take the *Journal* of the Chemical Society as representing a standard example, it may be noted that the number of pages published in 1914 was 2,909, whilst in 1923 the number was 3,441. This was reduced in 1924 to 2,698 pages, but rose again in 1925 to 2,986 pages. The drop in 1923–1924 was not, however, due to lack of material but to the exercise of necessary economy because the costs of printing have increased by 70 per cent. since the war, and the funds of the society could not carry the increased expenditure. Until new sources of income could be created economy had to take the form of asking authors to cut down their papers to the greatest possible extent, and this had the effect of checking the advance for that year. Nevertheless during 1925, although authors continued to cooperate and still expressed their views and results in as small a space as possible, the steady rise in the amount of research work carried out in the country led to an increase in that year, showing that the new matter was due to new research and was not the outcome of any remissness on the part of the publications committee.

The increase is still continuing, and is a welcome sign of the healthy condition in which research in chemistry stands at the present time. Still it means a journal of well over 3,000 pages for 1926, and represents a condition of affairs which is shared by many other scientific societies.

There were many national scientific shortcomings revealed by the war, but it is probable that those in the chemical sciences loomed largest because they

were the ones which had to be rectified by makeshift arrangements at the time, and although our national aptitude rose to the occasion, and we blundered through in our usual manner, yet when time for thought occurred the contrast between our state of unpreparedness and the complete scientific equipment of our enemies was very marked, and gave cause for earnest consideration. The result has been a great increase in the numbers entering our chemical research schools and the consequent output of an increased amount of new knowledge, all of which has to be recorded. The burden of publication has fallen, therefore, heavily on the societies dealing with chemistry, and more particularly on the Chemical Society, which is the chief means by which, through its journal, new knowledge is published to the world.

The remedy is not obvious. The societies can not increase their subscriptions without inviting loss of membership. Neither does it seem that much is to be gained by amalgamation, because each society deals with some branch of chemistry, and there is little or no overlapping or duplication. Amalgamation of the societies would not, therefore, decrease the costs of publication nor materially diminish the subscriptions necessary to meet these costs.

You can not curtail papers beyond the point which enables the work described to be repeated, otherwise publication is valueless. You can not say within wide limits that new knowledge is not worth recording, or that views expressed are best suppressed. The criticism has been raised that the modern tendency to issue short communications at frequent intervals leads to premature publication, and that much that is published has to be corrected in later papers, and it can not be denied that recent experience has shown this criticism to be partly true. But it has been the custom of societies to accept short papers with more avidity than long ones, and in consequence authors have come to realize that the short communication stands more chance of acceptance than longer ones. The policy is in a sense wrong, because a series of short papers on the same subject necessarily leads to redundancy and frequently to a revision of the views expressed in earlier parts as the work progresses. The trouble seems to lie in the custom which requires an introduction to the series, the aim of which is to give the reader who has no interest in the experimental details a readable account of the scope of the work. If this "introduction" were abolished and a "summary and conclusions" placed at the end of the paper or series of papers, it would no doubt crab the literary style of the author and detract from the value of the communication as bedside reading matter, but it would most certainly shorten the paper and would no doubt enhance its value from the scientific standpoint.

When it is remembered that there are some 23,000 scientific periodicals published throughout the world the mind stands appalled at the prospect that will confront civilization even in so short a time as 100 years hence, unless some general method of curtailment is agreed on. The space occupied by our ever-increasing libraries must cause alarm to those who contemplate the possibilities of the future. The agreement between the various societies dealing with chemistry to form a joint library at Burlington House means at the present time an increase of something like 800 volumes yearly—an increase which will augment as time goes on. In the not far distant future the library will occupy the whole of the space available in the society's apartments, and the same problem has to be faced by every other scientific society. Indeed, civilization seems to be confronted with two ever-growing problems—the increase in its cemeteries and its libraries. The former, no doubt, will be solved by cremation. Is it too much to hope that a judicious exercise of this method may also be applied to our libraries?

J. F. THORPE

SCIENTIFIC EVENTS

THE INTERNATIONAL GEOLOGICAL CONGRESS AT MADRID[1]

THE fourteenth session of the International Geological Congress was held in Madrid towards the end of May last. It was presided over by Senor D. César Rubio y Munoz, under the honorary presidency of His Majesty King Alfonso. Senor Rubio is the president of the Board of Mines and was formerly president of the Geological Institute, entrusted with the preparation of the geological map of Spain. His successor, Senor D. Domingo de Orneta, who was to have taken an active part in the meeting, died shortly before it was held.

The Geological Congress is almost the sole survivor of the scientific congresses which formerly played such an important rôle in international scientific comity. It is still open to men of science of all nations, a distinction to which the scientific unions constituted under the International Research Council can lay no claim.

After a preliminary meeting of the government delegates on the previous day, the congress was formally inaugurated by the King on Monday, May 24. The total number of members was more than a thousand. Many of these had already taken part in excursions to the Canary Islands and Morocco, or to Huelva, famous for its cupriferous pyrites, or other places of geological interest in the south of Spain. Toledo, Aranjuez, Almaden with its mines of mercury and

[1] From *Nature*.

the Guadarrama Mountains that separate Old from New Castle were visited during the meeting and afterwards there were other excursions to the Balearic Islands, the potash deposits in Catalonia, the Pyrenees, the important coalfield of Asturias and the iron ores in the neighborhood of Bilbao.

The Spanish government and the municipalities of Madrid and of the towns that were visited in the excursions extended splendid hospitality to the members of the congress. There was a royal reception at the palace, a gala theatrical performance, a municipal garden party and a banquet at which the speeches, twenty-seven in number, commenced with the fish course. This was followed by a charming exhibition of national costumes, dances and singing, in which the performers were all amateurs.

In spite of these attractions, time was found in the different sections of the congress for valuable discussions on matters of current geological interest.

There were a number of contributions on recent physical methods of studying the configuration and economic possibilities of the rocks of particular areas by electric, magnetic and gravimetric methods, and observation of the propagation in the earth's crust of artificially produced

The pyritic deposits of the south of Spain, to which reference has already been made, were the subject of important papers, and the greater part of two days was devoted to the discussion of the question as to whether they were formed by replacement or owed their origin to magmatic or pneumatolytic intrusion or deposition. Considerable attention was also given to the part played by Hercynian and Alpine movements in mountain building, more especially in Spain.

Perhaps, however, what was of the greatest interest to the British representatives was the consideration of questions of African geology in connection with the proposed international geological map of Africa on a scale of one in five million, which was resolved on at the previous congress at Brussels in 1922. A number of representatives of British African surveys were present as well as those of France, Belgium, Spain, Portugal, Italy and Egypt. It was gratifying to note the progress that has been made in the interval. A geological map of the whole of South Africa has been recently published on a scale of one in one million, and one of Egypt on a scale of one in two million and of South-West Africa on the same scale. Maps of the Anglo-Egyptian Sudan and Somaliland on a scale of one in three million, of the Gold Coast on one in one million five hundred thousand and Gambia on one in five hundred thousand and of all the remaining British African colonies or mandated territories, Nigeria, Uganda, Kenya, Tanganyika, Nyasaland, British Bechuanaland and Northern Rhodesia, as well as of Southern Rhodesia, on a scale of one in two million, have been prepared and work on other parts of Africa is well advanced. The map of the whole of Africa on the scale of one in five million will be prepared under the auspices of the Belgian government as soon as all the materials are ready.

Of permanent value as a conspectus of the geology of Spain are the excellent guides, some nineteen in number, to the excursions. Many of them are published not only in Spanish but also in French, English or German, or more than one of these languages. At the same time the municipality of Madrid presented the members of the congress with a well-illustrated volume on the Quaternary rocks of the Manzanares Valley by José Péres de Barradas.

The greatest achievement of the congress, however, was the re-creation among geologists from all parts of the world of the atmosphere of friendliness and cordiality that prevailed in the days, which now seem so remote, "before the war."

THE SECTION OF VOLCANOLOGY OF THE U. S. GEOLOGICAL SURVEY

THERE was established on July 1, 1926, a Section of Volcanology in the Geologic Branch of the survey. Mr. W. C. Mendenhall is chief geologist directing the activities of the Geologic Branch in Washington. Mr. T. A. Jaggar at the Hawaiian Volcano Observatory is volcanologist in charge of the new section. The Section of Volcanology is empowered by act of Congress to operate volcanologic surveys, measurements and observatories in Hawaii, including subordinate stations elsewhere, and to provide and maintain laboratories and quarters for the work, and to print reports.

This establishes a government service for continuous observation of volcanic action in the United States and its dependencies, with headquarters on Kilauea volcano. In immediate effect it enlarges the scope of the Hawaiian observatory so as to create experiment stations to study volcanism in California and Alaska, these making their reports to the Hawaiian headquarters for publication and comparison. Hitherto the Hawaiian station has been the only permanent American volcano observatory.

Lassen National Park, where was staged in 1914–15 an eruption in the northern California mountains at Mount Lassen, and where there were other eruptions from 100 to 250 years ago, has been selected for the second. This second volcano observatory will be in charge of Mr. R. H. Finch, associate volcanologist, who has been first assistant at the Kilauea station since 1919. His task is to establish an earthquake laboratory modeled on the one in Hawaii, equip it

with seismographs, man it winter and summer and make studies also of slow movement of the mountain, of weather controls and of underground temperatures as shown by the springs and gas vents.

The seismographic laboratory at the Hawaiian station is placed in charge of Mr. Ronald M. Wilson, topographic and geodetic engineer. Mr. Wilson becomes geodesist and mathematician to the Section of Volcanology, as aide to Mr. Jaggar in physical investigations, and will specialize in tilt measurements and change of ground levels in relation to tide-water, and in horizontal movement determined by precise triangulation. Of late years work in Japan, California and Hawaii has proved that these slow movements are of enormous importance in relation to earthquakes and volcanoes and that they have forecasting value.

Another officer in charge of the clerical and disbursing work of the Section of Volcanology is Mr. Richmond B. Hodges, stationed at the Hawaiian laboratories. Mr. Hodges has served through the grades of junior and assistant clerk in the Washington office of the U. S. Geological Survey. He will have charge of the records, files and accounts at the Hawaiian observatory, and of part of the drafting and editing.

Mr. Jaggar made reconnaissance of the Lassen district in 1925 and 1926. The Topographic Branch of the U. S. Geological Survey, Colonel C. H. Birdseye in charge, is now at work making a topographic administrative map of the Lassen Park and surrounding country of the National Forests. This map will be of great importance to the volcanologists. Furthermore a monograph on the recent eruption of Lassen, by Drs. Day and Allen, of the Geophysical Laboratory, excellently prepares the field for permanent studies of volcanic energy there.

For the present the program of publication of the section of volcanology is to issue weekly reports of earth shakings, tilts, temperatures and other volcanic phenomena observed at all stations occupied. These are given the local press in the vicinity of each observatory, and are collected every week in the Volcano Letter for wider distribution. In the *Monthly Bulletin* of the Hawaiian Volcano Observatory will be published the fuller illustrated reports from each station, in this as in other things the Hawaiian laboratory becoming the mother station.

The third observatory of volcanic action planned is naturally in that wonderful region almost unknown, the Aleutian mountains and islands of Alaska. That land will be reconnoitred for the purpose in 1927, and among the many volcanoes there belonging to the United States one will be selected for laboratory study winter and summer. Financial aid to supplement the small work that the government funds can do will be essential to any thorough research in that country. T. A. J.

THE INSTITUTE OF CHILD GUIDANCE

THE Commonwealth Fund has announced the establishment on July 1, 1927, of an "Institute for Child Guidance" of which Lawson G. Lowrey, M.D., will be director. The chief purposes of the institute, which is the outgrowth of the experience gained in the operation of the fund's five-year program in the field of prevention of juvenile delinquency, will be four:

1. To make possible further study and research in the field of mental hygiene for children, with special reference to the causes and methods of treatment of behavior problems.

2. To provide facilities for the training of psychiatrists and graduate psychologists in practical child guidance work. Annual fellowships for this purpose will be offered through the National Committee for Mental Hygiene with which the institute will be affiliated.

3. To provide field training in child guidance for students in psychiatric social work at the New York School of Social Work and the Smith College School for Social Work. Both of these institutions will be affiliated with the institute and will offer a number of fellowships in psychiatric social work provided by the fund.

4. To afford adequate clinical facilities for the thorough study and treatment of children presenting problems in behavior and mental hygiene. Cases will be accepted from parents, schools, and from various cooperating agencies.

The institute will be operated under the direction of an administrative board to include Frankwood E. Williams, M.D., medical director of the National Committee for Mental Hygiene; Porter R. Lee, director, New York School of Social Work; Everett Kimball, director, Smith College School for Social Work; William A. White, M.D., director, St. Elizabeth's Hospital, Washington; C. Floyd Haviland, M.D., chairman, New York State Hospital Commission; Mildred C. Scoville, executive assistant, the Commonwealth Fund; Barry C. Smith, general director, the Commonwealth Fund, and three other persons from the social and educational fields presently to be appointed. Under the directorship of Dr. Lowrey, a complete staff of psychiatrists, psychologists, psychiatric social workers will be provided.

With the establishment of the institute, the Bureau of Children's Guidance, at present operated by the New York School of Social Work, will be discontinued and other modifications of the fund's present program will be made. The National Committee for Mental Hygiene will discontinue, with the completion of the demonstrations now being conducted in Cleveland and Philadelphia, the operation of demonstration child guidance clinics. The committee will, however, maintain a field service staff which will offer advisory service to the community child guidance clinics (now six in number) already established as the result of

previous demonstrations and will provide consultant service to communities desiring to establish similar enterprises; it will also offer a consultant and advisory service to colleges and universities desiring to establish departments of mental hygiene.

The National Committee on Visiting Teachers, affiliated with the Public Education Association of New York, which has conducted thirty demonstrations of visiting teaching throughout the United States, will offer a similar consultant service to school systems which have established the work permanently following the demonstrations and to other school systems desiring to establish it. The committee will also offer two demonstrations of visiting teaching in connection with training schools for teachers.

The Joint Committee on Methods of Preventing Delinquency, which has already issued a considerable number of publications based on the work of the Commonwealth Fund program, will continue its work and anticipates the publication within the the next two or three years of a series of some twenty books and monographs, including complete reports of the work of the five years' program.

THE JULIUS ROSENWALD INDUSTRIAL MUSEUM

MR. JULIUS ROSENWALD has provided $3,000,000 for the establishment of an institution in Chicago, to be known as the Julius Rosenwald Industrial Museum. According to a note in the *Museum News* the museum is to be housed in the reconstructed Fine Arts Building in Jackson Park. Moves have been made to secure a charter from the State Legislature, and it is planned by the South Park Commissioners to set up a governing board for the new museum.

The development is an outgrowth of studies which its sponsor has made of museums in Europe, and announcements indicate that the Chicago undertaking is projected to be the world's greatest museum of industry. The plan was made public at a luncheon given by Mr. Rosenwald to civic leaders of Chicago, and hearty approval of it was expressed. The president of the Park Commission indicated that $5,000,000 —the proceeds of a bond issue—would be available immediately for reconstruction. Plans for interiors are being drawn by Graham, Anderson, Probst and White, who designed the Shedd Aquarium.

It is intended shortly to invite representatives of leading industries to a conference at which plans for exhibits will be discussed, and the industries will be invited to prepare and install exhibits. A comprehensive history of the development of each of our basic industries will be shown on a floor area of half a million square feet.

The *Museum News* remarks: "This project adds to the unique circumstances which attach to the industrial museum field. Until recently it was unrepresented in this country save by a few special museums connected with industrial establishments, a few exhibits in our larger museums and to a certain extent by the single American museum of commerce. In Europe, on the contrary, museums of industry are well developed and important. Here progress has been sudden and recent. Three separate movements for great museums in New York, Chicago and Washington have been launched."

CHEMISTRY AT ROCHESTER

THE program of the Rochester Section of the American Chemical Society for the year 1926–1927 is as follows:

October 4, Dr. Ernest Cohen, University of Utrecht, Utrecht, Holland.

October 18, Dr. David Klein, Wilson Laboratories, Chicago, Ill.

November 1, Professor H. A. Mattill, University of Rochester, Rochester, N. Y.

November 15, Dean Gerald Wendt, College of Physics and Chemistry, Penn State University, Philadelphia, Pa.

December 6, Dr. J. G. Lipman, New Jersey Experiment Station, New Brunswick, N. J.

December 20, Professor Otto Maass, McGill University, Montreal, Canada.

January 3, Dr. A. C. Fieldner, U. S. Bureau of Mines, Pittsburgh, Pa.

January 17, Dr. R. R. Mellon, Highland Hospital, Rochester, N. Y.

January 28 and 29, Regional Meeting. Eastern New York, Syracuse, Ithaca, Western New York and Rochester Sections. The speaker for the evening will be Professor B. S. Hopkins, University of Illinois, Urbana, Ill.

February 7, Group Meeting in which the section will divide itself into the four groups as follows: Industrial, Education, Physical and Inorganic, and Organic and Biological.

February 21, Dr. G. Goler, city health officer, Rochester, N. Y.

March 7, Dr. Robert McKay, International Nickel Company, New York, N. Y.

March 21, Professor R. Bullard, Hobart College, Geneva, N. Y.

April 4, Dr. J. A. Wilson, A. F. Gallum & Sons Co., Milwaukee, Wis.

April 18, Professor W. O. Fenn, University of Rochester Medical School, Rochester, N. Y.

May 2, Dr. W. Mitschling, Max Ams Co., Bridgeport, Conn.

May 16, Dr. E. K. Carver, Eastman Kodak Company, Rochester, N. Y.

SCIENTIFIC NOTES AND NEWS

AT the golden jubilee of the American Chemical Society held in Philadelphia this week certificates of honorary membership were given to Professor Bohuslave Brauner, University of Prague; Professor Giuseppe Bruni, University of Milan; Professor Ernest Cohen, University of Utrecht; Professor Frederick G. Donnan, University of London; Sir James Colquhoun Irvine, principal of St. Andrews University, Scotland; Professor W. Lash Miller, University of Toronto; Professor Charles Moureau, College of France; Professer Ame Pictet, University of Geneva; Dr. Ira Remsen, president emeritus, Johns Hopkins University; Professor Theodore W. Richards, Harvard University; Professor Joji Sakurai, Imperial University of Japan; Professor Paul Sabatier, University of Toulouse, and Dr. Edgar Fahs Smith, president emeritus, University of Pennsylvania.

DR. ALBERT F. WOODS, who recently resigned as president of the University of Maryland to become director of scientific research in the United States Department of Agriculture, has assumed his new work. Following the brief ceremony in which he took the oath of office, several hundred scientific workers in the department welcomed Dr. Woods on his return to the department with which he had been connected for sixteen years prior to 1900 when he accepted the position of dean of the College of Agriculture and director of the Agricultural Experiment Station of the University of Minnesota.

ANDREY AVINOFF has been elected director of the Carnegie Museum at Pittsburgh to succeed Douglas Stewart, who died on April 21. Mr. Avinoff has been a member of the museum staff since 1924 when he was appointed curator of entomology.

CHARLES P. COOPER, former president of the Ohio Bell Telephone Company, has been elected a vice-president of the American Telephone and Telegraph Company, in succession to Edgar S. Bloom, who resigned to become president of the Western Electric Company. Mr. Cooper, who is forty-two years of age, is a native of Ohio and a graduate of the engineering department of the Ohio State University.

C. E. SKINNER, chairman of the American Engineering Standards Committee, will be one of seven official delegates who will meet in London on September 1 to ratify the formation of an international standards association and to put the finishing touches on the constitution which was formulated during the Third International Standardization Conference which was held in New York, April 14 to 22, 1926.

DR. GARCIA MEDINA, director of national hygiene of Columbia, has been appointed by the government to represent Colombia at the hygiene conference at Washington this month.

PROFESSOR W. L. DE BAUFRE, head of the department of mechanical engineering at the University of Nebraska, has received a year's leave of absence in order that he may undertake research work in electric power development for the International Combustion Engineering Corporation of New York.

DR. OTTO JAEKEL, director of the institute of the University of Greifswald for geology and paleontology, has been elected a corresponding member of the Geological Society of London.

DR. CLAUS SCHILLING, of the Institute of Infectious Diseases at Berlin, has been elected a member of the malaria commission of the League of Nations.

DR. WALTER FEWKES, who has spent the summer in Arizona in the excavation of the Elden Pueblo ruin, expects to return to Washington during the first part of the month. As a result of his excavations there has emerged from the ground near Elden Mountain a rectangular building measuring 145 by 125 feet, containing nearly forty rooms and a large kiva, from a study of which a good idea can be obtained of the aboriginal architecture of the neighborhood surrounding Flagstaff.

DR. HARRISON G. DYAR, U. S. National Museum, has resumed work in the museum after several months spent in the west, chiefly at the ranger camp near Belton, Mont.

DR. W. R. MAXON, of the Smithsonian Institution, who recently returned from a collecting trip in Jamaica, has brought back specimens of some two thousand plants. Dr. Maxon's expedition was undertaken in order to complete the collection of Jamaican ferns in the Smithsonian collection. A monograph on the subject will be issued in a series published by the British Museum. This is a further step in the comprehensive plan of the Smithsonian Institution and several leading American botanical institutions to make known the flora of tropical America. The American Association for the Advancement of Science and the New York Botanical Garden financed the expedition.

DEAN H. L. RUSSELL, of the Wisconsin College of Agriculture, who has been on a leave of absence during the past year investigating agricultural conditions in the Far East for the International Board of Education, is again at his former position which he took up the first of September. Dean Russell's trip took him to Japan, China, Australia, New Zealand and the Philippines.

PROFESSOR W. J. MEAD, of the department of geology of the University of Wisconsin, has been granted

leave of absence for the college year 1926–27 and will give courses in metamorphic and structural geology as temporary professor of geology at the University of California.

PROFESSOR H. H. BARTLETT, head of the department of botany and director of the Botanical Gardens of the University of Michigan, will shortly sail for a year's botanical exploration in eastern Asia. He will visit Japan, after which field work will be carried out in Sumatra, in Formosa and possibly in Celebes.

DR. H. H. JUYNBOLL, director of the Royal Ethnographic Museum of Leyden, Holland, is visiting the United States with a view to inspecting a number of the larger museums with a view to making exchanges.

DR. LLOYD T. JONES, of the physics department of the University of California, and Professor Walter S. Weeks, of the mining department of the same institution, have been engaged by the East Bay Municipal Utilities District to develop and verify a theory of pipe-line stresses. The experimental work is being performed on the sixty-five-inch, ninety-mile-long, steel pipe that is to carry water from the Mokelumne River to Berkeley, California.

AFTER having been in Brazil for several weeks giving lectures in Rio de Janeiro and in other cities, Mme. Curie has sailed for France.

PROFESSOR T. TURNER retires from the Keeny professorship of metallurgy in the University of Birmingham this September.

DR. MORTIMER W. RAYNOR, superintendent of Kings Park State Hospital, will succeed Dr. William L. Russell as medical director of the Bloomingdale Hospital, White Plains. Dr. Russell becomes general director of the psychiatric work of the Society of the New York Hospital, of which the Bloomingdale Hospital is a department.

W. A. CLAXTON has been appointed chief of the division of health, department of public welfare, at Miami, Fla. Mr. Claxton for years was with the state board of health as district health officer on the lower east coast.

DR. WENDELL C. PHILLIPS, president of the American Medical Association, will address the Fifteenth Annual Safety Congress to be held at Detroit, October 25 to 29, on "The National Health Problem."

THE Royal College of Physicians, London, will celebrate in 1928 the tercentenary of the first publication of Harvey's "De Motu Cordis."

CHARLES S. BROWN, professor of mechanical engineering at Vanderbilt University, died on August 31, aged sixty-six years.

DR. ELIOTT P. FROST, professor of psychology at the University of Rochester, died on September 3, aged forty-two years.

Nature reports the death of William Fawcett, lately director of Public Gardens and Plantations, Jamaica, on August 14, aged seventy-five years; of Professor Robert Gnehm, professor of technical chemistry and afterwards director of the Technical High School, Zurich, who was known for his investigations on dyeing processes and dyestuffs, aged seventy-four years, and of Dr. J. F. Hall-Edwards, president of the British Electro-Therapeutic Society and a pioneer in the field of medical radiology, on August 15, aged sixty-seven years.

AT the Twelfth International Physiological Congress, held in Stockholm from August 3 to 7, the American Physiological Society through its president, Dr. J. Erlanger and its secretary, Dr. W. J. Meek, formally invited the congress to meet in America in 1929. The Italian physiologists also made a similar invitation, but on recommendation of the international committee the American invitation was accepted unanimously. Great interest was shown everywhere in an American meeting. With improving economic conditions in Europe the next congress bids fair to be the largest ever held. The Stockholm congress had close to 700 members, 88 of whom were Americans. It will be the duty of the American Physiological Society to select the place of meeting, make all local arrangements and decide what American physiologist shall act as president of the congress.

THE program of the Sixth International Congress of Philosophy, to be held at Harvard University from September 13 to 17, has been issued. Professor Ralph B. Perry, of Harvard University, is chairman of the program committee. President Nicholas Murray Butler, of Columbia, who is president of the congress, and President A. Lawrence Lowell, of Harvard, will give brief addresses of welcome on the first day, and Paul Lapie, rector of the University of Paris, will reply as representative of the foreign delegates. The session will be divided into four groups to discuss metaphysics, philosophy of science, theory of values and history of philosophy. Each group will hold discussion meetings in the freshman dormitories, and prominent scholars will speak at the general sessions. Among the foreign delegates who are expected to attend are H. Driesch, of Leipzig; F. Enriques, of Rome; H. Wildon Carr, of London; C. Bouglé, of the Sorbonne; Erick Becher, of Munich; S. Dasgupta, and S. Radhakrishnan, of India; A. Vassilieff, of Moscow; H. Weyl, of Zurich, and R. F. A. Hoernle, of Johannesburg, South Africa.

WE learn from the London *Times* that the biennial Congress of the Australian Association for the Advancement of Science opened at Perth, on August 23. The visiting delegates, numbering more than a hun-

dred, traveled by a special train from the East of Australia. In the party were retiring president, Sir John Monash, the president-elect, Professor E. H. Rennie, and other leading scientists and scholars of the Commonwealth of New Zealand. Professor Rennie's presidential address was principally devoted to an exhaustive analysis of the constituents of Australian plant products. He referred to their commercial possibilities and urged a vigorous policy of afforestation to provide against the extinction of valuable trees and plants.

THE Astronomy and Physics Club of Pasadena closed its program for the year with the following list of subjects and speakers: *Binary Stars,* Dr. R. F. Sanford, of Mt. Wilson Observatory; *Cepheid Variables,* Dr. R. H. Curtiss, of the University of Michigan; *Fluorescent Radiation from Incandescent Bodies,* Professor E. L. Nichols, of Cornell University; *Sun-spot Cycles,* Dr. S. B. Nicholson, of Mt. Wilson Observatory; *Extra-galactic Space,* Dr. Edwin Hubble, of Mt. Wilson Observatory; *Recent Development of the Saha Theory,* Dr. E. Freundlich, Potsdam, Germany; *Report of a Repetition of the Trouton-Noble Ether-Drift Experiment,* Mr. C. T. Chase, of the California Institute of Technology; *The Eclipse Expedition to Sumatra,* Dr. J. A. Anderson, of the Mt. Wilson Observatory; *Further Experiments on the Inertia of the Electrical Carrier in Copper,* Dr. R. C. Tolman, of the California Institute of Technology.

THE foot-and-mouth disease commission sent to Europe to study the research being done there on the problem returned after more than a year's stay. The commission, which consisted of Dr. Peter K. Olitsky, of the Rockefeller Institute for Medical Research; Dr. Jacob Traum, of the University of California, and Dr. Harry W. Schoening, of the Federal Bureau of Animal Industry, is now engaged in writing its report of the survey. After studying the research work and the control measures employed in France, Germany, England, Denmark, Sweden, Holland, Belgium, Switzerland, Austria, Hungary and Italy, the commission established itself at the Institut d'Hygiene, Strasbourg, and later also at the Laboratoire National de Recherches, Alfort, France. Experimental studies were made at these institutions on the causal agent of foot-and-mouth disease from its physical, chemical and biological aspects. Particular attention was given to certain phases of the problem bearing on methods of control of the disease used in this country. European investigators and officials gave the fullest cooperation and expressed their approval of the commission's work. It is hoped that this effort will result in solving some of the problems of this disease which causes such great economic losses all over the world. Members of the commission returned at the time because the appropriation for the study lapsed on July 1.

UNIVERSITY AND EDUCATIONAL NOTES

Nature reports further details of the will of the late Dr. J. E. Bles, who left all his scientific instruments, scientific books and the fittings and contents of his private laboratory to the University of Cambridge. Dr. Bles empowered his trustees to expend a sum, not exceeding £500, in completing any researches made by him and publishing the results of any researches not published at the time of his decease. The value of his estate was £42,677; failing issue, and subject to his widow's life interest and after certain bequests, he left the residue of his property to the university for a professorship of animal embryology to be called the Charles Darwin professorship and subject thereto upon similar terms for a professorship of bio-physics.

THE entire $30,000 estate of the late Albion W. Small, dean of the graduate school of the University of Chicago, has been bequeathed to the university for the founding of a publication in the field of social science. Dr. Small, who was seventy-four years old at the time of his death last March, came to the university when it opened in 1892 as head of the school of sociology. Prior to that he was president of Colby College, Maine.

DR. S. C. LIND, associate director of the Fixed Nitrogen Research Laboratory, has resigned to become director of the school of chemistry of the University of Minnesota. A division of photo- and radio-chemistry will be added to the chemical curriculum.

DR. RICHARD B. MOORE, formerly chief chemist of the U. S. Bureau of Mines and since 1923 director of research with the Dorr Company, of New York City, has been appointed dean of the school of science and head of the department of chemistry at Purdue University.

DR. BENJAMIN B. WATSON, who recently resigned from the Sir James Young Simpson chair in obstetrics and gynecology in the University of Edinburgh, arrived in the United States on September 1, having accepted a similar chair in the college of physicians and surgeons of Columbia University. Dr. Watson will also be the director of the Sloane Maternity Hospital. He succeeds in both positions the late Dr. William Studdiford.

AT the University of California, Professor Raymond T. Birge has been promoted from associate pro-

fessor of physics to a full professorship. Professor A. Joffé, director of the Technical Physical Institute of Leningrad, Russia, will be a member of the physics staff during the spring semester, 1927. He will give a course on "Physics of Crystals" and will be available to direct research work of graduate students.

DR. FRANK M. LIFE, professor of physics and head of the department at the University of Arizona, has been appointed head of the College of Letters, Arts and Sciences, to fill the place of Professor Frank C. Lockwood, who has a year's leave of absence.

DR. C. L. WITHYCOMBE has been appointed university lecturer in advanced and economic entomology in the University of Cambridge.

THE council of the University of Manchester has made the following appointments: Mr. H. E. Buckley to be lecturer in crystallography; Miss Margaret S. Willis to be assistant lecturer in geography; Dr. C. E. Brunton to be demonstrator in human physiology; Dr. O. R. Howell, lecturer in applied chemistry in the faculty of technology; Mr. Robert Grindley, demonstrator in chemical technology in the faculty of technology.

DISCUSSION

WHAT CONSTITUTES PUBLICATION? A QUESTION CONCERNING NOMENCLATURE

IN SCIENCE, No. 1631, p. 362, I note a summary of Opinion 87 of the International Commission on Zoological Nomenclature: "Printer's proof sheets do not constitute publication and, therefore, have no status under the International Rules of Zoological nomenclature." No zoologist could be found, I suppose, who would dispute this salutary ruling;[1] but on reading the full opinion, the example selected to illustrate it appears to me unfortunate and the statement of the case misleading. It is the case of the "Smithsonian Miscellaneous Collections, 000."

In the Century Dictionary a proof sheet is defined as "a printer's proof," which is "a trial impression from composed type taken for correction." The printed matter referred to in Opinion 87 is a stitched octavo pamphlet of twelve leaves. The first leaf has the title quoted above, and an introduction (continued on page 2) stating the subject and author (W. G. Binney), and signed by Joseph Henry, Secretary, S. I., dated "Smithsonian Institution, Dec. 9, 1863." The following pages, numbered 3 to 12, are printed on one side of the paper only, all being left-hand pages.

Professor Henry referred to this paper in these words: "As a mere proof which will undoubtedly receive many corrections, these pages should not be quoted as authority, or referred to as a published work." This is certainly a naïve suggestion. Most zoological publications "will undoubtedly receive many corrections," even those of to-day; ours is not an exact science. The mere statement that the paper is a "proof" can not make it a "proof-sheet" if it is not one. As a matter of fact, it was never intended as a proof sheet in the true sense of that term. It is a pamphlet, stitched and paged, dated, furnished with a formal introduction to the reader, and sent out widely by a responsible scientific institution, not for the correction of typographical or similar errors, but to obtain "information relative to the subject of these researches" and "contributions of specimens . . . serving to illustrate local faunas," etc.

I need only add that the paper in question is a common one. The statement in Opinion 87 that it was sent out "to a limited number of persons interested in the study of mollusks," though apparently a mere assumption without documentary evidence, is doubtless true. But the limit was evidently placed high enough to reach all persons who would be interested, for the paper is still easy to get, over sixty years since it was issued. Many years ago I procured a copy from a dealer, and within the past year was given another among miscellaneous pamphlets on mollusks. A colleague here tells me that his copy was handed him three or four years ago by a friend who had it in duplicate. In the library of the Academy of Natural Sciences I find it duly bound with other "Smithsonian Miscellaneous Collections."

It is clear that the Smithsonian Institution gave this paper a general circulation among shell collectors and conchologists of its time, and doubtless supplied it to all inquirers. It was only by such general distribution that the objects of the publication could be attained. To claim that this paper was not published appears, to put it mildly, disingenuous. It does not belong to the class covered by the summary of Opinion 87.

It was in this pamphlet that the name *Carinifex newberryi* Lea first appeared. In the opinion under consideration, it is claimed that there was not "any indication" which of the species which had been named *newberryi* might be intended by Binney's *Carinifex newberryi*. This claim does not appear to be tenable. It should be understood that the work was a list of all North American species of air-breathing mollusks, classified under families and subfamilies, systematically arranged. Up to that time (1863),

[1] The only case which I recollect of proof sheet names finding their way into published works is that of W. E. Leach, whose proofs of a projected work were quoted by J. E. Gray many years ago.

three[2] species of mollusks had been named *newberryi*. One of them, *Melania newberryi* Lea, is not an air-breathing mollusk, and belongs to a family not included in the scope of Binney's work. This leaves two species for consideration: *Ancylus newberryi* and *Planorbis newberryi*. *Ancylus newberryi* Lea was duly enumerated by Binney among the Ancylinæ (p. 11) and is thus eliminated. *"Carinifex newberryi* Lea" was placed by Binney in the Planorbinæ, and could be nothing else than *Planorbis newberryi* Lea, which does not otherwise appear in the list. Nobody ever thought it was anything else. The name *Carinifex* passed into general use, and has appeared in hundreds of papers, here and abroad. It was never questioned before.

The name *Megasystropha* Lea for *Planorbis newberryi* was published in April, 1864. It was proposed "provisionally" by Lea, probably in the belief that as *Carinifex* had not been *defined*, it could be displaced. It was an era of scant courtesy between systematic conchologists.

While Binney's way of introducing a new generic name is not to be commended, it appears to me a needless disturbance of nomenclature to replace *Carinifex* by the later, still-born and clumsy name *Megasystropha*.

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BOWMANVILLE LOW-WATER STAGE OF GLACIAL LAKE CHICAGO

IN Dr. D. J. Fisher's very interesting account of the geology of the Joliet Quadrangle[1] (page 102) a low-water stage is described as occurring between the Glenwood and Calumet high-water stages of Lake Chicago. It is gratifying to have this low-water stage again affirmed, as the writer showed evidence of its existence a number of years ago[2] following the earlier statement of its existence by Dr. Andrews.[3] The name given it by Dr. Fisher can not be used, however, as the writer gave this stage a formal name in 1920—the Bowmanville. Evidently Dr. Fisher has not seen the writer's "Life of the Pleistocene," in which the history of the life of Glacial Lake Chicago is described in great detail, based on a study of the entire length of the North Shore Drainage Channel, which cut longitudinally through the bed of old Wilmette Bay. The stages of the glacial lake there outlined are as follows: Glenwood, Bowmanville (= Evanston), Calumet, Toleston, Sag Low Water, Hammond, Englewood. The name Bowmanville is formally described on page 69 of the volume, "Life of the Pleistocene."[4]

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INHERITANCE OF ACCESSORY MAMMAE

In *Science* for June 11, 1926, Dr. W. W. Keen cited a case of the transmission of extra nipples and breasts from father to children, and states that "it would be very interesting to learn whether this peculiarity was passed on to his grandchildren." Some references to the inheritance of the anomaly are given by Deaver and McFarland in their book, "The Breast" (Philadelphia, 1917), including the study of Marie on the incidence of polymastia in four generations of a French family. A similar complete and equally remarkable case, also involving four generations, has recently been published by Klinkerfuss (*Journal of the American Medical Association*, April 19, 1924, p. 1247). More remarkable still are the experiments of Alexander Graham Bell on multi-nippled sheep (SCIENCE, n. s. 9: 637).

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SCIENTIFIC BOOKS

Plants and Man, A Series of Essays relating to the Botany of Ordinary Life. By F. O. BOWER, Sc.D., LL.D., F.R.S., Emeritus Professor of Botany, University of Glasgow. Macmillan and Co., Ltd., London, 1925. pp. xxi, 365.

IN spite of William Beebe, the exception who proves the rule, it is well known that there is a dearth in this country of writers of the so-called "popular science." It is perhaps not so widely realized what a handicap this entails. However, the recent "evolution trial" was denounced much more harshly in the British and Continental press than in our own. This may have been due to the European public being informed in science largely through the medium of a popularized literature. The writer has recently come across a book by F. O. Bower, published last year in London, which is believed should prove of wide appeal among "laymen" in this country. Only occasionally is one reminded of its British origin, as in "tyre," "Kitchen Garden" and "Dessert Fruits."

The purpose of the book "is to explain, for the general reader, in very general terms, how plants fabricate for their own life commodities that man

[2] Not four species, as stated in Opinion 87. *Goniobasis newberryi* Lea, 1863, is not a fourth species, but only a change of the generic name of *Melania newberryi* Lea, 1858, as a reference to Lea's paper will show.

[1] Bull. Ill. Geol. Surv., No. 51.

[2] Trans. Ill. Acad. Sci., IV, p. 110.

[3] Trans. Chi. Acad. Sci., II, pp. 1–24, 1877.

[4] Univ. Ill. Bull., Vol. XVII, No. 41, i–xiv, 1–476, pl. i–lvii, 1920.

finds so useful in his. The intention is to give a bird's-eye view of these far-reaching processes." It consists of a series of essays showing how botany relates to everyday life. The fact that these were originally newspaper articles indicates that they are of general interest. The author presents his subject in an interesting and original manner. It is an instructive and authentic book written in non-technical language.

An American quotation begins the book. How plants alone can harness the radiant energy of the sun and store it up in forms useful to man and how plants manufacture starch is told in vivid style. The author makes this astonishing statement: "The chlorophyll-containing cell . . . is the prime source of the food of all things . . . the most decisive organic agent at work upon the earth's surface." A fundamental difference between plants and animals lies in the fact that the former have theoretically an unlimited body, while that of the animal is fixed at a relatively early date. The size of plants is mechanically limited, because, says Bower, "while the weight increases as the cube of the dimensions the strength increases only as the square."

The fixed position of the plant body brings difficulties, in the protection against animal attack, in effecting pollination and in the dissemination of the seed. The author says, "The wonder of it all is that plants thus stationary have succeeded as well as they have done." The competition between grassland and woodland is described and the reason for it is given. While we do not commonly have moors in this country, we all are familiar with them through song and story. Here we find the why and wherefore of it in simple language. The adaptation of plants to mountainous regions is discussed and we feel quite at home as the author speaks of the White Mountains of New Hampshire and Tunnel Mountain near Banff. He says, "There is in fact a close affinity of the mountain flora of North America with that of Scandinavia and of the Scottish hills and ultimately with that of all Arctic lands."

Man is dependent upon plants even for his play. He takes for granted the greens of the golf links, the lawn for tennis and croquet with never a thought of how it was prepared and how it is maintained in good condition. The author points out that there are three factors in the construction of seaside links, *viz.*, (1) the rocky skeleton, (2) the plants which act as dune builders or holders of the soil, and (3) the skin of mixed vegetation.

Bower exposes the secrets of how new kinds of flowers, fruits and vegetables are produced when he discusses hybridization, grafting and artificial selection. The history of common fruits and vegetables becomes a romance. Another interesting story is how man changes the natural rôle of fruits when he uses them for food.

We have all heard the old tale of wheat sprouting after it has been lying in some Egyptian tomb for centuries, but what is the actual truth of the longevity of seeds? Bower gives the case of the seeds of Sacred Lotus which germinated after they had been kept dry for one hundred sixty years. Much has been written about cereals, but it would be hard to find in the same space elsewhere as much interesting and useful information.

Plants in their mechanical construction involve engineering principles used by man, although, of course, there is no connection between them. Wood is discussed as to its nature and use. The author proves its durability, when animal and fungal life is excluded, by citing the case of some oak piles that supported the Roman bridge at Maintz. After their removal these piles, sound as the day they were driven by the Romans, were purchased by a piano manufacturer. Bower shows that plant fibers, such as cotton and flax, have been known to man from the dawn of civilization. He likewise demonstrates their use and complete regulation to the needs of the plant.

The spread of plants is discussed, showing how man is the controlling factor, although other influences are not belittled. We are told of plant robbers which prey on other plants. "The result of parasitism may be stated quite generally for any living type, including even man himself: once the individual reaches maturity, physiological dependence and degradation tend to go hand in hand."

Mycorhiza, one of the most interesting of all plant phenomena, is a relation between certain fungi and the roots of higher plants. In some cases, as, for example, certain orchids, the plant has become so dependent upon the fungus that its seeds will not grow unless the fungus be present. The author makes quite clear what is meant by fungus and fungal parasitism and shows why a study of the fungi is necessary for successful agriculture. Bacteria, as well as fungi, are briefly discussed and their relation to such important things as soil fertility, diseases of plants and animals, vinegar, "retting" of hemp, indigo, butter, cheese and tobacco are mentioned. Their part in scavenging and sanitation is well described.

Bower shows man's dependence upon vegetation for his food, his shelter, his clothing, his curative drugs, his arts and his luxuries. In the case of vegetable dyes, pigments and essential oils, man has in some instances been able to produce them synthetically, but artificial rubber yet remains to be produced on a commercial basis. The book closes with an exposition of man's influence upon vegetation, the

author showing both destructive and constructive phases.

ALFRED H. POVAH

NORTHWESTERN UNIVERSITY

THE STANFORD RESEARCH INDEX CARD

IN 1816 George Crabb introduced his now famous book, "English Synonymes," with the words: "In the prosecution of my undertaking, I have profited by everything which has been written in any language upon the subject; and although I always pursued my own train of thought, yet whenever I met with anything deserving of notice I adopted it, and referred it to the author in a note." Every research worker, no matter what the subject of his investigation, would like to be able to use these words in introducing his paper or book to the public.

To-day, with somewhat more than twenty thousand scientific periodicals *at our disposal*,[1] the finding of what has been written on any certain subject and the digging out of what is deserving of notice are projects whose completion, as a usual thing, can be only approximated. It is indeed the rare instance where an author feels this sublime assurance that he has "caught everything." I have no solution to offer for this predicament of the researcher of the present as he tries to arrive at a proper ratio between laboratory and library work. Chasing literature is of course almost certain to "pan out" in the long run or average run, and it is only justice to those who have labored that we should take some pains to know what they did, but this point of view seems to provide one with what amounts to a full-time job. We are dazed at the thought of the automobile traffic of the future and likewise at its scientific literature problem. In scientific papers of the next century how will it be possible to give each individual his due right of way and protection from extinction! Even now we need any comfort and aid in this work that can be discovered.

A familiar line that is apt on the matter of reference research is the phrase: "When found make a note of it." This suggestive advice should be supplemented by the emphatic commentary: "And make enough of a note." The time and energy spent in relocating articles, which have been seen but were not "noted," or which were noted inexactly or too briefly, is a begrudged and particularly irritating expenditure. This item of loss can not be wholly avoided, but possibly it can be largely reduced.

[1] World List of Scientific Periodicals, 1900–1921, Oxford University Press, 1925. This list actually gives 24,128. These are supposed to be the living ones. But dead periodicals have to be looked after and then too the birth-rate in this realm shows no sign of decline.

We use blank forms with economy in almost numberless situations in the business world. We use them likewise in gathering our scientific data and in the classification and working up of such data. Is it not possible to do the same in the matter of gathering scientific references and abstracts? Research, no matter what the laboratory or the subject, involves a certain scheme that is more or less evident in all scientific articles, especially those that report experimental work. This likewise constitutes the basis for most good scientific abstracts. This formula is as follows: name of worker, statement of problem, description of material (phenomena or subjects) worked upon, discussion of method or apparatus used, the results and conclusions and the place of publication. Obviously such a schematic arrangement is not difficult to provide for in a simply printed form, and this may serve as a convenient frame on which to place, in an orderly manner, all sorts of scientific content. The 4 x 6 inch card reproduced herewith has been developed from this standpoint and is offered as an aid in the organization of working abstracts of scientific literature.[2]

The upper part of the card is divided vertically so that it may be conveniently filed under author or topic. In addition to the author's name there is space to indicate if desired: the year when the work was actually done which sometimes is importantly different from the publication year; pertinent information about the author, such as his training, special competency, position, other articles or what not, and his address. "Lecturer" is used as alternate to author in the belief that one's index on a certain topic should contain a card for an important or special lecture, interview or conference, that he may have listened to on the subject.

The date when the reference was noted and the name of the abstractor may be entered in the upper right-hand corner. The file number or notebook number and page of location for fuller abstract or related material are provided for. There is space to note who cited the work if one is unable to consult or see it himself, to record in what library it is available and the call number. This latter is often a time saver.

The title line gives enough "area" for most authors to announce what they are writing about. If the card stands for a book the next line will be used in naming the publisher, city, date and perhaps price. If it is an article this line will carry the name of periodical with the date, volume and page. It seems worth while to devote one line to a general characterization expressing the abstractor's analysis from the standpoint of type of article, and his appraisal of its merit or

[2] These cards may be had from the Stanford University Bookstore.

AUTHOR OR LECTURER | TOPIC | DATE NOTED
DIVISION | NAME
YEAR DONE | CONCERNING AUTHOR | FULLER ABSTRACT | FILE NO. | NOTEBOOK NO. | P
RELATED MATERIAL
CROSS INDEXED
CITED BY
ADDRESS | AVAILABLE AT | CALL NO
TITLE
JOURNAL OR BOOK PUBLISHER
PRICE | CITY | DATE | VOL. | PART | PP
CHARACTERIZATION | MERIT RANK
TABLES | FIGURES | BIBLIO. | FEATURES
SPECIFIC PROBLEM
DATA COLLECTED BY
MATERIAL OR SUBJECTS
METHOD OR APPARATUS
RESULTS AND CRITICISM (OVER) | STANFORD RESEARCH INDEX CARD

A form for use in the making of abstracts of scientific literature.

importance. The makeup of the article as a presentation of scientific material is indicated by way of number of tables, figures, size of bibliography and any special features. It may be one specific part of the article or problem that is of interest, in which case this may be stated. Possibly the abstractor can word the problem more accurately than the title of the paper gives it. The data are not always collected by the author of the paper; hence the short line provided for a note here. The card is so arranged that "material" or "method" may expand into more space if necessary. The back is for the statement of results, criticisms or whatever is pertinent.

A space for everything, but no need to fill in every space! Gaps in such a case are worth while; they provide room to add something later; the having of space for certain notes makes for more careful analysis of the materials under review. Different things will be filled in at different times. First the author and journal may be discovered probably in some topical bibliography. Later, perhaps, the exact title, and the page and volume items will be checked when the periodical is actually consulted. Gradually there is produced a rather complete working abstract, accurate in details concerning the article, with not too much trusted to memory. Uniform arrangement makes for ready reference when using the cards on lectures or otherwise. On printed forms abstracts are more understandable to a second party.

The card described may aid librarians who have charge of scientific collections as well as assist the student or research worker in making "enough of a note" as to save repeats in looking up references. It will promote the making of more exact and practically useful abstracts and perhaps may thus reduce a little the scientific literature burden.

W. R. MILES

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ABSOLUTE MEASUREMENT OF AVERAGE SIZE OF DROPLETS OF THE DISPERSE PHASE OF AN EMULSION

IT was desired to find a method for measuring in absolute units the average size of droplets of the disperse phase in a permanent emulsion of the oil-in-water type. It was found that if a single drop of an emulsion of this sort is deposited on the surface of clean water in such a way as not to break the surface film, it will spread on the water like an oil. The spreading takes place with extreme rapidity and may be considered as being almost a two-dimensional explosion.

The mechanism of the spreading is not yet entirely clear, but if the concentration of the emulsion is suf-

ficiently high, none of the oil phase goes below the surface. Assuming that the layer on the surface is one particle deep and that the droplets are small enough in diameter to hold their shape, the average diameter of the particles can be measured by the same method as used by Langmuir[1] for measuring the cross-section of oil molecules. By this method, measurements of the same emulsion at two different concentrations are consistent with each other and with measurements made with varying quantities of emulsion.

Measurements are made as follows: An enameled iron tray about eight inches wide, thirty inches long and two inches deep is filled about half full of water. A piece of parafined Al foil is floated on the surface at one end of the tray and attached to a balance exactly as in the Langmuir apparatus. The rest of the water surface is then swept free of monomolecular layers of grease, oil, etc., and a drop or two of the emulsion is caused to spread on this clean surface. Voids are eliminated by pushing the film up against the Al foil by means of a paper sweeper, and the area of the film is determined exactly as in Langmuir's experiments with oil films.

The calculation of particle size requires a knowledge of the total volume of the droplets of the disperse phase *as they exist in the emulsion.* Although, in our experiments to date, this volume is the same as that of the same mass of undispersed material, it would be premature to say that this must always be the case. This volume may be obtained by curdling a known volume of emulsion with a known volume of a solution of a suitable electrolyte, removing any included water from the curd and adding it to the rest of the water-phase. The total volume of the water-phase is then measured and the volume of the disperse phase is found by difference. This gives at once the concentration C of the emulsion. Then the average diameter of the droplets of the disperse phase in the emulsion is

$$d = \frac{CV}{A}$$

where V is the volume of the emulsion which was spread on the water and A is the area which is covered.

This method was developed at the Research Laboratory of the General Electric Company. It is a pleasure to express my thanks for their permission to publish it.

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STATE COLLEGE, PA.

[1] Proc. Nat. Acad. Sci. *3*, 251, 1917.

A SURFACE TENSIOMETER AND AN OSMOMETER FOR CLASS WORK

APROPOS of articles in recent numbers of SCIENCE (June 11 and July 2) on the ring method of measuring surface tension and, in the latter article, on the application to this purpose of a chainomatic balance, it may be of interest to add a note descriptive of a piece of apparatus, based on the principles of the above, which we devised over a year ago and which was successfully used by our class in general physiology during the past session. Our problem was to contrive something so cheap and simple that a class of well over a hundred students doing individual work might each be supplied with an outfit. The diagram will explain the general features. The balance lever is a thin strip of bamboo of which more than a sufficient number for the whole series was obtained from a small Japanese mat. Strips of aluminum clipped on to each end and to the center of the bar were punched to a standard pattern. A piece of platinum wire bent to form a circular loop of known circumference is suspended from one arm and from the other a white metal chain of suitable length and known weight per linear unit, terminated by a piece of thread as illustrated. The wooden support is graduated behind the chain and, for the rest, a few pins serve to suspend and confine the balance arm. The dish containing the liquid to be tested is most simply held in the hand but may be supported at the proper level for greater accuracy.

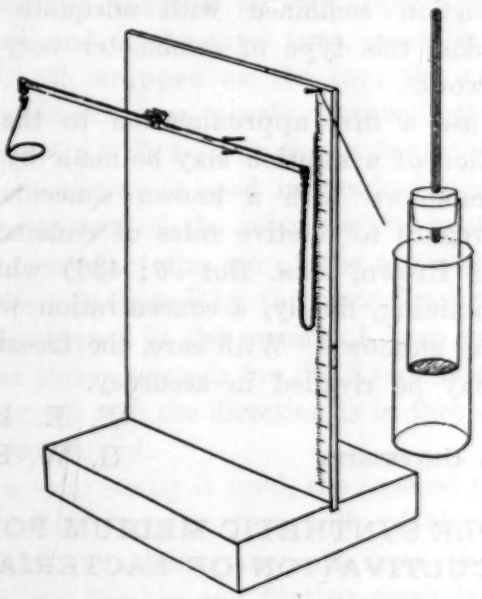

FIG. 1

With a little care individual readings of the surface tension of water do not vary more than $\pm$ .3 to .4 per cent. ($= \pm$ .5 mm on the actual scale).

As illustrating the type of results obtained in class we include a curve taken from a student's notes. Among other relations set for investigation we may mention those of surface tension to the time factor

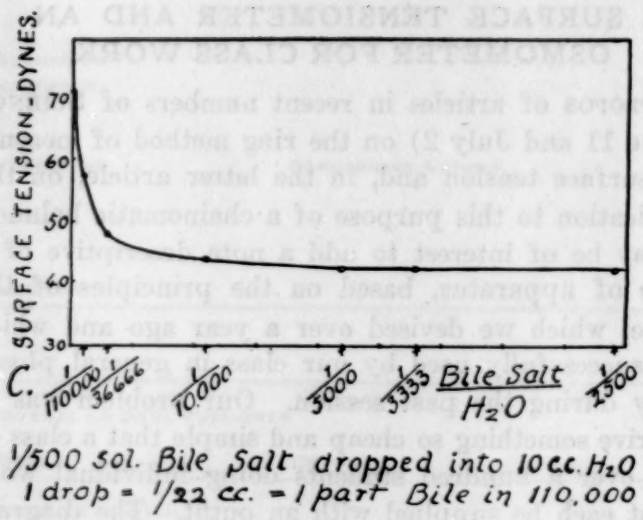

FIG. 2

(after adding bile, protein, etc.) and to toxicity in the case of the alcohol series. The experiments absorb little time, possess an intrinsic fascination and should speedily bring an apprehension of fundamental principles.

Another useful and educationally valuable piece of apparatus largely used by the same class of students is the osmometer, illustrated in the adjoining diagram. The students construct it individually according to Tamman's method (see Philip's "Physical Chemistry"), the copper ferrocyanide membrane being deposited in a film of hardened gelatin on the end of a piece of glass tubing, into which a capillary tube is fitted by means of a rubber stopper. Ease of construction combined with adequate working speed renders this type of osmometer very suitable for class work.

In its use a first approximation to the osmotic concentration of a solution may be made by comparing the unknown with a known concentration of sugar in regard to relative rates of endomosis from water (see Brown, *Ann. Bot 36*: 436) which helps toward obtaining, finally, a concentration which will balance the unknown. With care, the freezing point method may be rivalled in accuracy.

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MCGILL UNIVERSITY G. W. SCARTH

A SIMPLE SYNTHETIC MEDIUM FOR THE CULTIVATION OF BACTERIA

IN the course of studies carried out under the direction of Professor C.-E. A. Winslow in this laboratory it has seemed important to devise a highly simplified synthetic medium in which the test organism used (a strain of Bact. coli) would grow and in which the effects upon its growth of the various electrolytes could be studied without interference from impurities in the medium. After considerable study the following medium has been devised:

Ammonium tartrate, recrystallized	5 grams
Lactose (Mulford)	5 grams
Ammonium phosphate $(NH_4)_2HPO_4$	.01–.02 grams
Distilled water	1,000 cc

The reaction of the medium after sterilization is between pH 5.0 and pH 5.2. The lactose and tartrate produce no visible ash on oven treatment, but in spite of the absence of electrolytes often considered necessary the strain of Bact. coli studied has persisted with apparently undiminished vigor in this medium for twenty-three generations. No attempt has been made to study other organisms, but it has seemed worth while to describe the medium in case it may be of use to other students of similar problems.

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SPECIAL ARTICLES

THE MOTION OF A SPINNING TOP BEFORE IT REACHES THE GROUND

A GOOD deal of interest has been taken in the motion of spinning tops of various shapes and spinning under various conditions, and a study of the problems involved has in recent years proved to be of considerable practical importance. In spite of all that has been done I have found in the literature which I have examined nothing about the motion of an ordinary top while the string is still unwinding and the top in the air. I recall as a youngster knowing that if a top is to land on its toe and spin as it should it can not always be thrown right side up. But on the other hand it often is possible to throw a top right side up, and have it stay right side up and spin merrily.

It is evident that after a top has got up a good spin any continued pull of the string is likely to introduce a torque that will cause precession and so change the direction in which the toe of the top points. But just what the conditions are under which the top should be held in a given position, just how the spin is caused to be mainly about the axis of the top, and just how the torque acts are matters that are not immediately clear. With certain simplifying assumptions it may be that a mathematical analysis of the problem would not be difficult, but the following simple treatment seems sufficient to explain the more obvious facts.

First, as to the position in which the top is actually held. If the string is sufficiently long, the top may be thrown with the toe pointing straight down, but as the string is made shorter it becomes necessary, if the top is thrown horizontally and without initial angular velocity, to tip the axis farther and farther. With a string of only moderate length I have no diffi-

culty in spinning a top on its toe, and yet throwing it with the toe pointing straight up.

When holding the top with the toe pointing up, I find that if I am throwing it with the right hand it is easier to get it to spin if the string is wrapped like the thread of a left-handed screw, and when throwing it with the left hand to have the string wrapped like a right-handed screw. I then try to throw the top so that its initial motion is horizontal and without angular velocity and so that the pull of the string is horizontal. The string does not usually pull in a direction exactly opposite to the initial velocity, but is wrapped a little farther around the top. The angle between the initial direction of the string and the initial motion of the top may vary a good deal—it may run from 90° up to 180°.

In order to understand what happens consider first the more difficult case where the string is fairly short and the top is held with the toe pointing upward. In Fig. 1 the motion of the top is referred to a system

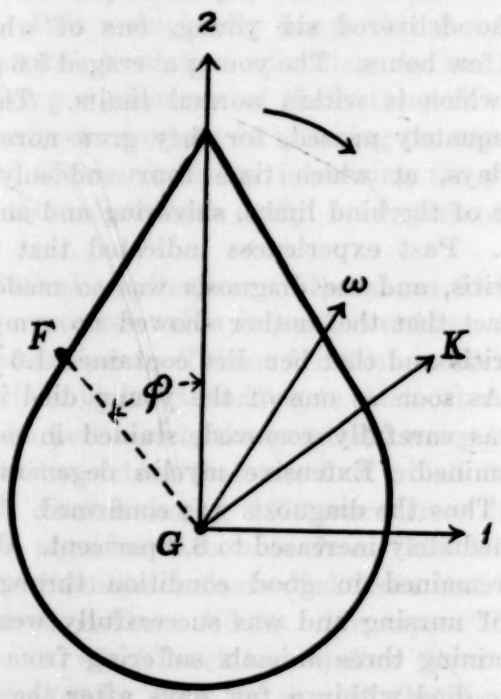

FIG. 1. Spinning top and various axes.

of three mutually perpendicular axes, 1, 2 and 3, which are fixed in the body and meet at the center of mass G. The axis 3 is to be thought of as coming straight toward us, so that the system is right-handed. Let the string be wrapped left-handed, and let the free end come straight toward us at F. After the top leaves the hand two important forces act on it. One is its weight W, and the other is the pull F exerted by the string. F is equivalent to an equal and parallel force F' through G, and a certain torque K. Since both F' and W pass through the center of mass they have nothing to do with rotation of the top, and we are not concerned with them.

At first the top has by hypothesis no rotation, but K immediately begins to produce angular momentum about its own axis. Since the moment of inertia in an ordinary spinning top is less about axis 2 than about axis 1, the axis of resultant angular velocity lies above K in some such position as is indicated by ω. For the top that I have used the most, the moments of inertia about the axes 1 and 2 are approximately $A = 100$ g·cm² and $B = 60$ g·cm², and the string is wrapped to a point such that the angle φ is about 51°. Under these circumstances it is easy to show, if ω_1 and ω_2 stand for the component angular velocities about axes 1 and 2, that we have initially

$$\frac{\dot{\omega}^2}{\dot{\omega}_1} = \frac{A}{B} \tan \varphi = 2.1.$$

Since the initial value of $\dot{\omega}_2$ is only a little more than twice that of $\dot{\omega}_1$ it is not at first clear how the string can set up an angular motion in which ω_2 becomes large without ω_1 becoming large. The explanation appears to be that as the top begins to turn about axis 2 it carries the axis 1 back behind the plane of the paper without producing much change in the position of K. The result is that the part of K which produces angular velocity about axis 1 rapidly decreases, while the part which produces angular velocity about 2 is not greatly changed. A considerable angular velocity is soon produced about axis 2, and without any great velocity about either axis 1 or axis 3. Thus as the top turns faster the axis of resultant angular velocity approaches the axis of the top, and at the same time, since less and less string is still wrapped on the top, the axis of the torque becomes more nearly perpendicular to the axis of the top. It follows that a larger and larger part of the torque is used in producing precession, and by some one of the rules for the sense of precession we see that the toe of the top must turn in the direction indicated by the curved arrow. When the top is thrown in the manner I have indicated it turns over slowly enough for the direction of turning to be observed, and the direction is in fact that which we have just found.

When a long string is used, the axes of torque and angular velocity are at first both of them close to axis 2. As the string unwinds from the top the torque swings farther and farther away from axis 2 and the angular velocity, and precession is set up as in the other case. But in this case the angular velocity about axis 2 is large before any considerable part of the torque is used in producing precession, so that the precession is slow and the top does not turn over very far before the string is entirely unwound. Thus when the string is long enough the top may be thrown with the toe pointing downward.

After the string leaves it the top is no longer subject to any appreciable torque, and so falls without further precession but maintaining the direction it had when the string left it. In spite of this last fact being so well known, it may possibly be worth mentioning that I have been able to spin a top on a table only a few centimeters below my hand, and have also thrown a top a number of times from a window more than ten meters above the ground. Every time that the top was thrown from the window spinning it fell without turning over and landed on its toe, whereas when it was dropped from the window without spin it usually turned over on the way down.

ARTHUR TABER JONES

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A VITAMIN B DEFICIENCY MANIFESTING ITSELF FOR THE FIRST TIME IN THE SECOND GENERATION

Two years ago the author was engaged in a series of feeding experiments in which it was desired to determine as far as possible the results upon reproduction of feeding a diet which was considered adequate in all respects except a possible deficiency or excess of the vitamins contained in cod liver oil and butter fat.

The diet used was uniform throughout, except for variations in the content of cod liver oil or other fat soluble vitamin containing foodstuffs. It was composed as follows:

Casein (purified)	18 per cent
Steenbock's No. 40 Salt	4 " "
Agar agar	8 " "
Dextrine	65 " "
Crisco	5 " "

Whatever of vitamin-containing fat was added was done by replacing an equivalent amount of Crisco. The drinking fluid was made up to contain:

Water	86.4 per cent
Lemon juice	12.0 " "
Fleischman's yeast (dry)	1.6 " "

The lemon juice was added as a carrier of Vitamin C. This was done because, in my experience, better results were obtained when the anti-scorbutic was used than when it was not. It has been maintained in this laboratory that as long as the anti-scorbutic vitamin is so plentifully supplied in practical dietaries it is necessary to include it also in synthetic diets in order that experimental conditions may compare as closely as possible to natural ones. Yeast was added at a level of 1.6 per cent. because it was noted that at this level a rat ingested the equivalent of 200 mgs per day, the amount which Osborne and Mendel[1] found sufficient to carry a rat through life at a normal rate in all respects.

Although the bulk of the data from these experiments is being reserved for a more complete report, it is desired at this time to state that the reproductive ability of the animals on these diets varied greatly. Cod liver oil was fed at levels varying from 0.25 per cent. to 5.0 per cent. On the diets containing enough cod liver oil to insure reproduction, the death-rate was very high. The clinical and pathological findings seemed to group the deaths in more than one class according to the most outstanding features. It is the purpose of this communication to submit evidence concerning one of these groups and the dietary changes that were necessary to obviate this difficulty in raising young on synthetic diets.

In experiment 60 four females and one male were receiving the above basal ration containing 2.0 per cent. cod liver oil. In order to conserve space, the history of only one female will be given. When female No. 279 was 168 days old (on the diet 140 days) she delivered six young, one of which died within a few hours. The young averaged 5.6 grams in weight, which is within normal limits. The young were adequately nursed, for they grew normally for fifteen days, at which time four suddenly showed paralysis of the hind limbs, shivering and an extreme diarrhea. Past experiences indicated that this was polyneuritis, and the diagnosis was so made in face of the fact that the mother showed no symptoms of polyneuritis and that her diet contained 1.6 per cent. yeast. As soon as one of the young died its sciatic nerve was carefully removed, stained in osmic acid and examined. Extensive myelin degeneration was found. Thus the diagnosis was confirmed. The yeast was immediately increased to 8.0 per cent. One of the young remained in good condition throughout the period of nursing and was successfully weaned. Of the remaining three animals suffering from polyneuritis, one died within a few days after the yeast addition; one recovered completely and was weaned and the remaining one improved sufficiently to have its life prolonged for several days.

The mammary glands of the mother showed histological evidence of active secretion. The stomachs of the young that died were filled with milk. Because of these facts and since the animals gained steadily in weight except at the very last (the diarrhea was very severe) it was concluded that starvation could not be a contributing factor. It was also considered that this was good evidence in favor of separating Vitamine B into two factors, one growth promoting and one preventative of polyneuritis.

There is thus demonstrated a dietary deficiency which is not manifested until the appearance of the second generation. As far as the writer knows, this

[1] Osborne and Mendel, *Jour. Biol. Chem.*, 54: 739, 1922.

is the first evidence offered, indicating that the maternal organism will not always deplete its own stores in favor of its young. It also makes apparent the necessity of increasing the Vitamin B intake in the diet of an expectant mother and maintaining this increase at least through the lactation period. This will have to be regarded as prophylactic treatment because of the inability to diagnose a condition of Vitamin B shortage until after the onset of the symptoms when the institution of curative measures is of little or no avail.

The curative effect of increasing the yeast intake after evidences of polyneuritis were seen was almost nil. Therefore it is concluded that by the time clinical evidence of polyneuritis has become manifest the progress of the disease has so far advanced that recovery is extremely doubtful. This conclusion naturally infers the fact that there are changes occurring in an animal due to a deficiency of Vitamin B that give no visible evidence of their existence. These changes can affect the organism before birth as well as after. It is undoubtedly due to this fact that there is a prenatal limitation of litters in mothers who are receiving a minimum of the anti-neuritic vitamin. The experience of others in bettering the reproductive ability of their animals by increasing the yeast content of their diets can easily be explained on this basis.

The clinical application of the above findings will be of the greatest value in such countries as Japan, where, according to Takano,[2] infant mortality from beri-beri is so high. According to this author the mortality from beri-beri is the greatest among breast-fed infants to the extent that one half of all the deaths from this disease during 1923 were from this class. It is also significant to note from this author that while nine thousand infants died from beri-beri only five hundred mothers did so. He says: "There are instances in which sucklings suffer from beri-beri while the mothers show no sign of the disease. . . . One of the reasons for the high death-rate among infants is the fact that infantile beri-beri cases are, as a rule, apparently nourished and have no apparent complaints, so that when it is diagnosed as beri-beri, it is already in the advanced stage of the disease and accordingly its prognosis is unfavorable." These remarks bear out some of the conclusions mentioned above.

IRA A. MANVILLE
UNIVERSITY OF OREGON MEDICAL SCHOOL

RATE OF GROWTH OF YOUNG LOBSTERS

DURING the summer of 1920 I undertook the problem of estimating the rate of growth of young lobsters. Having learned during the previous summer where to look for very young lobsters and how to capture them, I succeeded in capturing 262 lobsters under six inches in length. Of these 176 were under five inches, eighty-six were under four inches, and twenty-four were under three inches.

The contents of the stomachs of a number were examined, in order to learn something about the natural food of these animals, but that work has not been completed. The rest of the five-inch lobsters were liberated and the others retained for one year.

The 143 lobsters which were kept for further study were put into a large latticed box, divided by partitions into three compartments of different sizes. The latticed work was close, leaving only one quarter inch spaces between the pieces. The bottom of the box was covered with stones and sods of eel grass to make conditions as nearly natural as possible. For convenience the compartments were labelled I, II, III. In compartment I seventeen lobsters, having an average length of 2.86 inches, were placed. In compartment II we put sixty lobsters, having an average length of 3.60 inches. In compartment III we put sixty-six lobsters having an average length of 4.53 inches.

A suitable place was then selected, some distance from shore. The box was properly weighted, and so situated that there were several feet of water above the box at low tide. In this way all danger from ice was avoided. By means of a method which we devised, the lobsters were provided regularly with food and they were free to live practically in the same way as if they were free. They could burrow and hide among stones.

One year later the three compartments were again examined and the following results obtained. In compartment I fourteen out of seventeen were found alive. The average length was 3.97 inches. In compartment II thirty-two were found, having an average length of 4.75 inches. In compartment III thirty-six were obtained, with an average length of 5.79 inches.

Hence a lobster measuring 2.86 inches was found one year later to measure 3.97 inches, thus showing a yearly growth in length of 1.11 inches. In the same way a lobster measuring 3.60 inches grew to 4.75 inches, thus gaining 1.15 inches. Also a lobster measuring 4.53 inches grew in one year to measure 5.70 inches, thus showing an increase of 1.17 inches.

The expense of this investigation was borne by the Biological Board of Canada and the work was done under the supervision of the chairman, Dr. A. P. Knight.

D. A. MACKAY
COLLEGIATE INSTITUTE, OTTAWA

[2] Takano. *The Jap. Med. World*, 6:8, 1926.

THE INTERNATIONAL CONGRESS OF PLANT SCIENCES

THE Ithaca meeting of the International Congress of Plant Sciences, the fourth International Botanical Congress, formally typified the re-establishment of full cooperation among the botanists of all nations. That the participation from overseas was substantial and not merely symbolic was testified by the presence of about a hundred European and Asiatic visitors among a total attendance of about a thousand, as well as by the fact that approximately one half the papers presented were by foreign guests. Thirty-five of the nations invited to send delegates responded with letters of formal thanks to the committee, and of these twenty-five were represented by one or more botanists in attendance at the congress.

The choice of the Cornell University campus at Ithaca, N. Y., as the place of meeting was an especially happy one. Easy of access for delegates landing at New York City, Ithaca is located in one of the most interesting regions on the continent from the standpoint of ecological and systematic botany; while the existence on the campus of one of the greatest of American agricultural experiment stations, together with the near proximity of some of the most highly developed orchard and agricultural lands, was of great advantage to those interested in the applications of plant science. The prevailing rainy weather during the week interfered to a slight extent with the various field trips, but in matters which were under their control, the committees on program and local arrangements left little to be desired. The printed programs were ready on time and contained all necessary information, and mimeographed abstracts of the papers were available when the section meetings got under way. The machinery of registration ran smoothly, and all visitors were comfortably housed in the university dormitories promptly on arrival. The ample spaces of Willard Straight Hall afforded abundant opportunity for the "visiting around" that is after all the best part of such a gathering as this. The various auditoriums were made easy to find, and were so well chosen that only in a few instances did any overcrowding occur.

Quite in keeping with all other local arrangements were the brevity and comfortable informality of the opening exercises on the evening of Monday, August 16. Dr. Liberty Hyde Bailey, as chairman, introduced President Livingston Farrand, of Cornell University, who bade the members of the Congress welcome. On behalf of the foreign visitors, A. B. Rendle, of the British Museum, responded. He told of the genesis of the meeting: how the Fourth International Botanical Congress was originally planned for England in 1915, and how, as a result of the war, it was first postponed and then yielded to the United States. Mr. Rendle also extended an invitation to a fifth congress, to meet in England in 1930; this invitation was unanimously accepted at a later business meeting.

A full statement of the events of the congress, or even a comprehensive summary, is obviously impossible within limited space; a very brief outline must suffice, pending the publication of the official proceedings, plans for which will be announced at a later date.

AGRONOMY

The programs of Tuesday and Wednesday were given over to invitation papers, mainly by visitors from abroad. Of especial interest to American agronomists, for comparative purposes, was the initial paper, "Nature and agriculture in dry regions of the U. S. S. R.," by N. M. Tulaikov, of the Saratov Agricultural Experiment Station, and the initial paper on Wednesday, "The introduction of seeds and plants into Russia," by D. N. Borodin, of the Russian Agricultural Agency in America. Other papers on these programs were by Alessandro Marcello, of Venice, D. N. Prianishnikov, of Moscow, J. Stoklasa, of Prague, and A. T. Kirssanoff, of Leningrad.

On Thursday the section met with the section for genetics in a joint session devoted to the discussion of breeding for resistance to plant diseases, and on Friday it held a joint session with the sections for physiology and horticulture.

BACTERIOLOGY

The first independent meeting of this section was held on Thursday, when four papers on variability in bacteria were read. Hilding Bergstrand, of Stockholm, was of the opinion that many bacteria now regarded as separate species, *e.g.*, certain of the streptococci, are simply variants of one species. Observed changes in the form of *B. diphtheriae* in hanging drop cultures he likened to changes that are familiar as ecological variations in the higher plants. He felt that evidence is not yet sufficient to support a theory of sexual processes among bacteria.

Ralph R. Mellon, of Rochester, N. Y., regards form changes heretofore dismissed as involution forms, as possibly incipient new species, and disagreed with Professor Bergstrand on the question of sexuality. Arthur T. Henrici, of the University of Minnesota, stated that he had found a correlation between the size and stainability of bacteria and the stage of growth of the culture in which they were found. The general impression left by this session was that even such specific lines as have been drawn among bacteria may be wiped out, leaving the whole phylum in a state of constant evolutional flux.

CYTOLOGY

The sessions of the section for cytology were devoted almost entirely to chromosomes and their bearing on genetics and taxonomy. B. Nemeč, of Prague, gave a detailed account of the mechanism of mitosis. He was followed by William Seifriz, of the University of Pennsylvania, who discussed recent results of his work on the structure of protoplasm. His microphysical experiments on the elasticity of protoplasm lend support to a fibrillar theory of structure, as against a picture based on an emulsoid. Kathleen B. Blackburn, of Armstrong College, Newcastle-on-Tyne, reviewed the question of sex-chromosomes in dioecious plants and presented valuable new data. The question of chromosome numbers and arrangement in relation to various phases of taxonomy was discussed by Otto Heilburn, of Stockholm, and a communication on a similar topic from M. Nawaschin, of Moscow, was read. Nils Svedelius, of Upsala, and M. Ishikawa, of Tokyo, discussed the cytology of certain algae.

MORPHOLOGY, HISTOLOGY AND PALEOBOTANY

The most outstanding papers in this section were those on the evolution of plants. The lead was ably taken by Robert Chodat, of Geneva, the section chairman, who developed particularly the structure of the early land plants of the Devonian, and also outlined a theory of vascular development at variance with the most commonly accepted ideas of stellar structure. Rudolph Florin, of Stockholm, advanced evidence for a high antiquity of the Abietineae, frequently stated to be more recent than the Araucarineae. Carl Mez explained his method of determining plant relationships by means of serum diagnosis, and presented a phylogenetic tree based on his results. In a paper read by A. W. Hill, J. Hutchinson, of Kew, presented the reasons why he has departed from the Engler system. An especially stimulating session was the Thursday symposium on the structural evidences for genetic relationship, participated in by Nils Svedelius, of Upsala; C. J. Chamberlain, of Chicago; R. B. Thomson, of Toronto, and summed up by J. M. Coulter.

ECOLOGY

The congress presented the ecologists of England, the Continent and America with a chance to exchange views and iron out differences. The succession idea, at first slow to take hold on the Continent, seems to have achieved orthodoxy there, while Continental methods of exact survey are gaining respect on this side. Section Chairman Eduard Rübel outlined the comprehensive plant geography survey that has been made in Switzerland and displayed some fine vegetation maps that have resulted from it. The vexed questions of vegetational units and of factors affecting succession were thrashed out by H. C. Cowles, of Chicago; A. G. Tansley, of Cambridge; G. E. du Rietz, of Upsala; W. H. Pearsall, of Leeds; G. E. Nichols, of Yale, and W. S. Cooper, of Minnesota. W. Szafer told of the discovery of a series of interglacial peat beds in Poland that show a succession from an Arctic phase to a *Tilia-Acer* climax and a recession to the Arctic again.

FORESTRY

The section for forestry spent one day in joint session with the ecologists, and the remaining three in comparing methods. A comprehensive program for the rehabilitation of Italian forests was outlined in a paper from Arrigo Serpieri and Aldo Pavari, of Florence, Italy. The importance of forests as climatic factors, usually minimized, was stressed by Rafael Zon, of the U. S. Forest Service. The work of the Indian Forest Service was discussed in a paper submitted by A. Roger.

GENETICS

It is characteristic of genetics more than of any other division of biology, that a good paper in this subject can not be summarized. Within the narrow limits prescribed by available space, it will therefore be possible merely to mention as especially interesting the papers of Ernst Lehmann, of Tübingen; Alfred Ernst, of Zürich; Erich von Tschermak, of Vienna; M. J. Sirks, of Wageningen; Georg Tischler, of Kiel; E. Malinowski, of Skierniewice, Poland, and G. Savastano, of Acireale, Italy.

HORTICULTURE

The enterprise of horticulturists of these latter days in calling to their aid the resources of ecology, physiology, genetics and indeed all branches of biology, making theirs one of the most catholic of plant sciences, was well evidenced. The newest results of the length-of-day phenomena worked out by Garner and Allard were reviewed, the physiological significance of various types of reserve food storage was discussed in several papers, and the influences of shading, temperature and other factors on both plants in the field and on fruits in storage were considered by a number of speakers.

PHYSIOLOGY

Perhaps in no other section of the congress were so many provocative papers presented as in the section for physiology. One of the most outstanding was read in the absence of its author, A. Ursprung, of Freiburg, by his American associate, William A. Beck. Professor Ursprung's paper did much to